INFANCY AND HUMAN GROWTH

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# INFANCY AND HUMAN GROWTH

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*To* B.
*and* K.
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# PREFACE

Growth is a word to conjure with. There is always some danger that the term will be used in a mystical or vitalistic manner which will defeat its scientific usefulness, but we may at least try to avoid this danger. The present volume aims to deal with early human growth at close range, by methods of systematic observation and of direct record.

Modern biology and medicine have given substantial status to the general problems of growth, and some of the most brilliant of current laboratory investigations deal with the mechanics and the physiology of development. Experimental biology and experimental medicine are gradually placing the phenomena of growth upon a firm basis of fact, and at the same time they are dissolving the ancient distinction between mind and body by bringing the functional and structural aspects of growth into integrated relation. Growth is a unifying concept.

The mental manifestations of growth are in a sense more elusive than the somatic, but there is no reason to believe that they are in a sphere apart or uniquely resistant to scientific formulation. The human mind grows and there must be natural laws of sequence, which order the bewildering progression of the psychological life cycle.

Chapter I of the present book takes an introductory glance at the total cycle of mental growth chiefly to suggest the close relations between the psychological and the biological aspects of developmental problems.

Succeeding chapters deal with individual studies of a widely diversified group of infants and young children whose behavior was comparatively investigated at periodic inter-

vals. By means of normative formulations of their advancing levels of maturity it has been possible to give objective expression to the course, the pattern, and the rate of mental growth in normal and exceptional children. Although, at the present stage of our methods, these measurements must be regarded as only approximations, the data are quantitatively presented by means of tables and of growth graphs. Unusual as well as usual growth complexes are discussed, but the emphasis throughout is on the normal aspects of infancy. All of the chapters bear directly or indirectly on normal mental growth.

The methods of study employed are an extension of those reported in an earlier publication on *The Mental Growth of the Pre-School Child.*[1] A Graded Developmental Schedule for the determination of monthly and trimonthly increments of development in the first two years of life was drawn up to secure more frequent, consecutive records of the behavior changes in infancy. This schedule which is now in process of further standardization is sufficiently discriminating to define certain significant individual differences and deviations in the early phases of development. Our data are chiefly concerned with the growth characteristics of the individual infant as revealed by a series of developmental examinations and by clinical case study. It has not been our purpose to trace intelligence in a restricted sense, but rather to characterize the tendencies and variations of the total complex of growth in relation to several fields of behavior—motor, language, adaptive, and personal-social.

How fundamental is the interdependence between development and duration? Is there a stable substrate of matura-

[1] Gesell, Arnold, *The Mental Growth of the Pre-School Child: A Psychological Outline of Normal Development from Birth to the Sixth Year, Including a System of Developmental Diagnosis*, Pp. 447. New York, 1925. The Macmillan Company.

tion which governs the growth of the infant? How far do nutritional, environmental, and conditioning factors enter into the complex of growth? General and specific discussions of these questions are undertaken in connection with the individual growth studies. The broad problem of heredity in relation to early mental growth and personality formation is considered in Part III, which deals with the significance of human infancy.

In July, 1926, the Yale Psycho-Clinic was granted funds by The Laura Spelman Rockefeller memorial for the support of research in the field of child development. The studies included in the following pages were for the most part well under way before this date, and the present publication is not to be regarded as in any sense a report of the extended research program. It seemed desirable, however, to embody an account (in Part I) of certain arrangements for child guidance and developmental observation which have been made possible with our new facilities.

I am indebted in many ways to members of the present staff of the Yale Psycho-Clinic, to my colleagues of the Institute of Psychology, and to members of the Department of Pediatrics of the Yale School of Medicine. I wish to acknowledge particularly the assistance of Miss Helen Thompson, Research Associate, in the statistical treatment and analysis of Chapter VII. Miss Elizabeth Evans Lord and Miss Ruth Wendell Washburn rendered much assistance in the developmental examinations. I am greatly indebted to them for their skill and pains, as well as for their patience in meeting the numerous exigencies which are always associated with clinical work with young children. I should also like to mention, though it must be in general terms, the coöperation which came so freely from social workers, nurses, and parents—to say nothing of the infants themselves!

I appreciate the courtesy of the editors and publishers in permitting reprint of material in articles which had appeared in their journals: (Chapter IV) "A Comparative Method for the Demonstration of Normal Development in Infancy," *The Journal of the American Medical Association*, April, 1926, Vol. 86, pp. 1277–1281; (Chapter XIV) "Hemihypertrophy and Twinning," *The American Journal of the Medical Sciences*, April, 1927, Vol. 173, pp. 542–557; (Chapter XIX) "The Measurement and Prediction of Mental Growth," *The Psychological Review*, September, 1927, Vol. 34, pp. 385–390.

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# INFANCY AND HUMAN GROWTH

## CHAPTER I

## THE CYCLE OF MENTAL GROWTH

### Some Psycho-biological Aspects of Birth, Age, and Maturity

The mind grows. This book attempts to deal with the beginnings of human behavior from the standpoint of growth.

Growth is one of the most fundamental manifestations of life. It may well be called a function, and as such it constitutes a subject for systematic inquiry even in the elusive sphere of mind. Particularly true is this for the period of human infancy, when the drama of development proceeds with such swift and varied action. Is the movement of this drama ordered and lawful?

All organisms, plant and animal, are under the necessities and limitations of growth. In the more complex orders of life, such as fish, amphibia, reptile, bird, and mammal, the postnatal period of immaturity has become a recognizable part of the individual life cycle, and plays an important rôle in the economy of that cycle. This period of infancy has become woven into the vast order of organic nature. Infancy is one of the most general and impressive of all the products of evolution. Infancy was evolved to subserve the needs of growth.

#### 1. THE SCIENTIFIC STUDY OF GROWTH

Growth has become one of the central problems of the biological sciences. This is conspicuously true in the field

of experimental biology and in the new embryology with its emphasis on developmental mechanics. Indeed, the physiology of development is fast becoming a subscience of far-reaching import both for the understanding and the control of living nature. Anatomy has ceased to be a descriptive science dealing with static completions; it investigates the origins, the plasticity and the modifiability of structure. Biochemistry inquires into the energetics of growth and into its regulatory factors. Biometry is interested in mathematical formulations of growth laws and constants. Psychobiology is concerned with the developmental nature and origin of all organic behavior and with the genesis of both human and infrahuman conduct.

No phantasmagoria of fairyland was ever half so interesting as the experimental investigations of biological and medical science which are now revealing bit by bit the mechanisms of growth. These investigations are picturesque in their diversity; yet they promise generalizing principles which some day will be synthesized from the accumulating data.

Growth is being studied in all forms of life: unicellular and complex; in plant and animal; in individuals and in groups. Curves of growth have been plotted for microscopic colonies and for populations of the earth. Studies range from the minute cell count delineation of the development of the nervous system of the salamander to broad quantitative studies of the physical growth of the Chinese.

The experimental investigations deal in amazingly ingenious and daring ways with the alterations of the growth process. The growing organism is subjected to modification of temperature, of light, of position, and of chemical and nutritional conditions. The limbs of the salamander are transplanted from one part of its body to another; the shell

of the incubating egg is varnished; the growth of grafted embryonic fragments of the chick is observed in detail; the endocrine system of the tadpole is surgically altered to note the developmental results; growth disturbances are produced by radium emanation or by artificial chemical changes. Innumerable studies have been made through dietary modifications. Even the effect of irradiated sawdust on the growth of the white rat is known! Some of the dietary factors in the nutrition of the white rat are so well known that the growth of the rat can in considerable measure be manipulated by man. Tissues detached from the body are preserved and "grown" in culture media.

The scientific attack upon the problem of growth is of comparatively recent date. It is an expression of man's incorrigible desire to understand how he has come to be what he is. The countless studies now in progress the world over will themselves grow in range and depth, and will yield new insight into the factors which determine all growth.

It is evident that growth may be studied from many different aspects.[1] Viewed from one aspect growth expresses itself in changes of size, form, weight, structure. These bodily changes can be studied in the gross by anatomist and anthropologist; in their finer detail by embryologist, histologist, and neurologist. From another aspect growth is a function of the body comparable to secretion or respiration — a dynamic series of biochemical or metabolic events. This is the fertile field of developmental physiology. In deeper and vaster perspective growth must be viewed historically

[1] No effort will be made in this volume to maintain a distinction between *growth* as dimensional augmentation and *development* as differentiation. The terms will be used interchangeably with contextual inflections. It seems to us virtually impossible to hold to the suggested distinction; and undesirable to abandon such an excellent word as *growth* in the discussion of physiological or psychological phenomena.

in terms of the whole story of the race. This is the evolutionary standpoint, which aims to interpret the manifestations of growth in the individual in terms of his total ancestry. To what degree and in what manner are phylogeny and pedigree the mechanical cause of ontogeny? This is a durable biological question. Finally, growth may be viewed from the dynamic aspect of behavior. As a creature grows it reacts in a changing manner. This changing is progressive. It, too, is a form of growth susceptible to systematic observation.

Behavior may well be the culminating and integrated expression of the growth of the individual. If this behavior is regarded as an index of the mind or the psyche of the individual it falls within the scope of genetic psychology. If the mechanics and the occasion of the behavior are studied in close relation to the associated physical and physiological aspects the problem becomes one of psycho-biology. Growth is a more or less unitary complex. A complete scientific account of growth would bring all the aspects into coördination, and define the conditions as well as evidences of mental growth.

The nontechnical term "mental growth" denotes the whole series of behavior changes which characterize the life history of the individual. This statement, while scarcely a definition, emphasizes the fact that behavior may be studied historically or developmentally, with reference to genetic sequence, and to relative change rather than to absolute ability. The characterization of these changes is as fundamental to the comprehension of the human "mind" as the embryologist's anatomical sections of the growing heart are fundamental to the delineation of the mature organ. The mind is an abstraction; growth is an abstraction; but the evidences of mental growth are real, concrete, and inexhaustible.

The present volume will deal particularly with the characteristics of mental growth in the first two years of human infancy. Nowhere does mental growth proceed as prodigiously and as dramatically as in this early phase of the life cycle. Our data were secured by means of repeated developmental examinations of individual infants. These examinations were made periodically and comparatively with sufficient frequency to bring the general course of mental development into biographic view.

The data are presented in the form of individual growth studies, and cover a wide range of subjects — subnormal, abnormal, average, atypical, and superior. The major emphasis is on the normal and ordinary aspects of growth. No rigid distinction is made between the usual and the exceptional data included. It is assumed that fundamentally the laws of growth are universal, and the unusual growth complexes are instructive because they serve to focus attention on the underlying mechanism of all growth. The pathological aspects, as such, are not emphasized in the clinical studies presented. Our purpose is not so much to elucidate mental processes or abilities as to consider the genetic or growth patterns in which these abilities are manifested.

The concrete genetic studies which will appear in ensuing chapters may be prefaced by a general discussion of the entire cycle of mental growth. Infancy is a transitional phase in a larger cycle of development, and to appreciate the position and import of infancy its relationships to the total cycle must be considered in their genetic perspective. These relationships may be formulated in a few broad questions as follows: (1) What general relation does the cycle of mental growth bear to the total life cycle? (2) Is the cycle of mental growth simple or multiple? (3) When does

the cycle of mental growth begin? (4) What is the span of the cycle of mental growth? (5) What is the nature of individual differences in the mental growth cycle? (6) What psychodynamic relation does infancy bear to the subsequent stages of the mental growth cycle?

These questions are so broad that they have theoretical application to the infancy of animals as well as of man. They will, however, be discussed with special reference to human infancy in this introductory chapter. The comparative aspects of the problem may be reserved for a later chapter on "The Preëminence of Human Infancy" (Chapter XVI.).

## 2. RELATIONS OF THE LIFE CYCLE AND THE MENTAL GROWTH CYCLE

What relation does the cycle of mental growth bear to the total life cycle? Some distinction may be made between these two cycles. Although Huxley and others have held that development and life are practically equivalent terms, "the life cycle" is after all but a generalizing designation of the whole span of existence. It covers the career of the organism in its entirety from inception to normal death. It comprises the total aggregate or complex of all structures, organs, and functions.

When the biologist resolves the individual into parts it proves that each organ, each system, and indeed each cell, has its own career. These more or less elementary components of the total complex have their own appropriate life histories. Blood cells are born and survive for a brief span of perhaps a month. Bone cells endure longer. Nerve cells originate in the foetal period and persist throughout life. Each organ pursues a curve of growth characteristic of the organ. The rhythms of separate parts, organs, and systems do not coincide. One organ may wax while another wanes.

Individual bones of the skeleton undergo ossification at certain times but each time is distinctive for each bone. Even the vertebral column does not take on its size and form as a single structure. There is a peculiar, separate time for the ossification of each separate vertebra.

Similar statements might be made about the muscular system, the vascular system, and the reproductive system. It has been found that each has its own cycle of growth. There is interaction; but there is also a high degree of specificity and a partial degree of autonomy. In summary, there is not an organ or organ system of the whole body which does not have its distinctive developmental cycle.

Now what is the relation of the cycle of mental growth to this intricate plexus of distinguishable cycles? Is mental growth a unitary end-resultant of the underlying plexus, an emergent expression of the total organic pattern of development; or is it attendant and accessory? Ultimately this question is, of course, a metaphysical one. Scientifically both alternatives may be tested. The whole cycle of behavior may be studied in its own right as though it were a unique and independent series of phenomena.

On the other hand it is the task of psycho-biological research to determine the anatomical, biochemical, and physiological correlates of the behavior values; to ascertain the influence of the different factors and to define the status of the psychological factor among all the rest. The problem is not the relationship between the mind and body in the orthodox sense. The problem is one of organic mechanism in which the interactions of numerous diverse factors are recognized and degrees and modes of interdependency between them are investigated. The growth of behavior assuredly has some consistent relation to the growth of the nervous system; but how is the latter affected by nutrition,

by endocrine conditions, by pubescence, by body type, and by body build? Does the behavior system achieve any measure of independence or domination with experience?

The growth of the mind is primarily the emergence of a sequence of behavior values based on the maturation of a nervous system, which system, in turn is bound up with the whole architecture and history of the body. The behavior system of the organism may well have some kind of freedom and control which is not present in associated systems, but it is also conditioned with varying directness and degree by those systems. Scientifically the cycle of mental growth is therefore to be construed in its intimate relation to the congeries of cycles which, taken together, really constitute the life cycle. It is unnecessary to make a self-subsisting entity of the mind. It seems more profitable to regard behavior as a major aspect and index of an intricate growth complex.

Many clinical cases demonstrate that special bodily conditions have a definite effect upon the course of mental growth. Other clinical cases of unusual bodily conditions suggest that the mental growth complex has a high degree of immunity or independent vitality. We have included illustrative case studies to show these diverse possibilities.

### 3. THE COMPLEXITY OF THE MENTAL GROWTH CYCLE

Is the cycle of mental growth simple or multiple? The term cycle is after all a generalizing designation which we employ for convenience of discussion. From the standpoint of time a cycle is only a series of moments or epochs bounded by a birth beginning and a death end. Substantively it is a course of events in this interval. Now just as the total organic cycle was divisible into separate cycles for separate organs and systems, so the cycle of mental growth may be

dissected into separate aspects or lines of growth. The growth of language may be separated from the growth of prehension, or from the growth of ideas of causality, and so on indefinitely.

These separate lines of growth will tend to cohere and to pursue coördinate courses which, in ample perspective, will resemble a single pathway, a simple cycle of growth. The constituent lines of growth must, however, be analyzed as separate components, if for no other reason than to discover the individual variations which may occur in different individuals and the identities which must occur. If there is an intrinsic common factor it can be ascertained only by dissecting the strands of the whole sheaf. The influence of age on fundamental aspects like retentivity, speed, or accuracy is another phase of the problem. The cycle of mental growth comprises dissolution and decline as well as increase and emergence. This argues that the complex cycle of mental growth must be described and measured not only in its unity but in its more or less concealed diversity.

In the individual growth studies in later chapters we shall cite instances in which there is palpable disparity in the rate of development of different lines of behavior in the same child.

### 4. THE BEGINNING OF THE MENTAL GROWTH CYCLE

When does the cycle of mental growth begin? The difficulty of this question does not make it altogether absurd. If the concept of growth cycle has any scientific validity whatever in the sphere of psychology there must be, at least theoretically, a zero point from which to reckon measurement and a zero hour from which to begin description. Conventionally and legally the age and career of the infant start with birth. Studies of his early mental development have been dated from birth. Biologically considered, how-

ever, birth is but a punctuation mark in a developmental continuum. Birth is placed at variable times for different species. It may come "relatively" early in the rabbit, born naked, blind, and feeble; it may come relatively late in the hare, born with fur, with vision, and with locomotivity. Birth probably comes at different "times" for different races. It does not bespeak a given grade of maturity, and still less does it represent the zero grade of mental maturity for man who has an intra-uterine period of existence of ten lunar months.

Biologically considered the whole period of immaturity is a continuum. Postnatal infancy merges by backward reference into the stage of the foetus, which in turn derives from the embryo, which in its turn derives from the germ. There is an obsolete meaning of the word "birth" which recognized this continuum. In this early sense birth referred not to natality but to that which was borne or carried in the womb.

The facts of human infancy cannot be grasped in true perspective unless the lineage of both body and behavior is traced back to the prenatal period. Evidences of organic behavior have been found as early as the first month of this period. A considerable complement of behavior capacities has matured by the middle of the foetal period. So advanced are these capacities that an infant may be born two or three months before the appointed time and still survive. The premature infant is a key to the understanding of the prenatal portion of the developmental cycle. It is evident that he can scarcely be studied at all from the standpoint of behavior without projecting the cycle of mental growth back into the period of embryo and germ. The theoretical issues which are raised by the interpretation of his behavior status are sufficiently important to call for a special analysis.

Chapter XV will consider the early development of the premature infant and the location of the beginning of the mental growth cycle in relation to the antenatal period.

Fertilization and not the natal day marks the commencement of the life cycle and there may be good reason for reckoning the cycle of mental growth in a similar manner. Normally, human infancy lies between ten months of preparatory development and some ten years of preadolescence. Birth is a moment of transition rather than of initiation.

### 5. THE SPAN OF THE CYCLE OF MENTAL GROWTH

What is the span of the cycle of mental growth? This question is a corollary of the previous one and yields no simple, ready answer. Broadly conceived, development is coëxtensive with life and embraces the phenomena of senescence and decline. In a more restrictive sense the question would oblige us to set a criterion of mental maturity and mark the termination of the mental growth cycle at that time or that stage. But is there any single adequate criterion for psychological maturity? Anatomical criteria such as carpal ossification, pubescence, or attainment of physical stature or brain weight would be quite beside the mark. The criterion must itself be mental. If one accepts the evidence of psychometric ratings as expressed in mental age, the saturation point for scoring on a graded intelligence scale is ordinarily reached in the early teens. Spearman has examined this and other quantitative evidence and comes to the support of the conclusion. He speaks of a fundamental common factor equivalent to general intelligence which he identifies with mental energy and designates as "g." ". . . the evidence indicates that the growth of 'g' does not continue to any appreciable amount after the ages of fifteen or sixteen, and perhaps even ceases some years

earlier. A person is thus adult in respect to 'g' long before he is so in respect of physical stature. And if such a conclusion is really opposed to the verdict of 'common sense,' why then it seems time that this verdict should be revised."[1]

If "g" (or its equivalent) is the most fundamental attribute of the abilities of man the curve of mental growth might be represented by a mounting line which reaches a plateau at sixteen years. The plateau would continue throughout maturity. Whether decline could in turn be represented by a single descending curve is open to question.

Suggestive as Spearman's conclusions and comments are in the matter, it may well be doubted whether the problem of mental maturity should be made to yield to such comprehensive simplification. If by growth we mean sheer increase in a measurable magnitude of a general character, the age assignments proposed may be legitimate. If by growth we mean a power to assimilate, to learn, to elaborate, to transconstruct, and to originate, then the single long plateau curve must give way to a congeries of curves which may show, at least in many instances, an upward trend to the brink of old age.

## 6. INDIVIDUAL DIFFERENCES IN THE MENTAL GROWTH CYCLE

What is the nature of individual differences in the growth cycle? Psychological differences among children and adults have been studied chiefly in terms of ability. This is natural because the measurement of abilities must be the starting point for defining differences quantitatively. These abilities have high correlation with age. The factor of growth which determines this correlation may, however, be investigated on its own merits.

[1] Spearman, C., *The Abilities of Man: Their Nature and Measurement.* New York, The Macmillan Company, 1927. P. 415.

The concept of growth is not identical with that of ability. Ability denotes a capacity to perform at a given level. Growth denotes a capacity to change in a constructive, progressive direction from one level of performance to another. This capacity is a form of plasticity which in post-adolescent years can only be measured by taking relatively long intervals of time into account. To say that a youth has attained a certain level of measured ability which represents his limit (call it limit X) is not defining his growth potency. Another youth may reach the same limiting level of ability but may exhibit markedly superior powers of assimilation in after years. Ability comes but wisdom lingers. Now wisdom comes slowly to the second youth, perhaps not at all to the first. This assimilative capacity is not a measurable ability in the ordinary sense; but it is a growth potency, a quantitative difference, of extreme dynamic importance which both common sense and psychology may insist upon. Our psychological methods are as yet unable to cope with this problem, notwithstanding the fact that one of the most significant factors of differentiation in society is just this one which relates to varying degrees and modes of mental growth during adult years. If any method can be found to measure this growth potency it will be discovered that the mental growth complex comes to no sharp and symmetrical end at some life stage, but arrests, declines, or dissolves at many different points along the pathway to "maturity" and senectitude.

The factor of growth potency probably resides in the inherent protoplasmic plasticity of the individual. It may be subject to variations in his endocrine constitution. It is however conditioned by opportunity, desire, motivation, — by grace of spirit.

The relations between growth and learning ability need

to be defined. Thorndike has made interesting measurements of adults learning algebra, foreign languages, science, and an experimental artifical language. He finds that in these fields ability to learn reaches its height at about 20 years of age, and remains there for some years to decline at a slow rate of about 1% per year. Cato learned Greek at 80.

The mental growth phenomena of adulthood and senescence are doubtless continuous with those manifested in infancy. If systematic data on these interesting phenomena were available, they would doubtless assist in a compre-[illegible]n of early mental growth. The available annals of [illegible]crity seem to indicate an all but complete arrest of [illegible]pment and crystallization of mental outlook in the [illegible] decades of life, and even earlier. The clinical ac-[illegible] of deficient and borderline mentality are eloquent in the same direction. Biography is full of significant instances of preservation and resurgence of growth powers. A most impressive example is in the mental life of Abraham Lincoln. It would be difficult to find a more consistent record of slow and steady growth, much of it documented with convincing evidence. The evolution of his written style is itself a remarkable growth phenomenon, psychologically viewed. Sandburg's biography from this standpoint is particularly effective in conveying a sense of the ripening or growing process which seasoned the thought and character of this great man.

Ralph Waldo Emerson kept a voluminous journal, which brings into conspectus the growth of his own mind from callow adolescence to green old age. Indeed, he seemed to be highly conscious of the growth changes which were taking place in himself and in his son. At sixty-two he noted that failing memory was compensated by increased power and means of generalization. At fifty-two he had written:

"My son is coming to get his Latin lesson without me. And I am coming to do without Plato, or Goethe, or Alcott." In the same year we find a pertinent mental hygiene entry: "Education. Don't let them eat their seed-corn; don't let them anticipate, antedate, and be young men before they have finished their boyhood. Let them have the fields and woods, and learn their secret, and the base- and foot-ball, and wrestling, and brick-bats, and suck all the strength and courage that lies for them in these games: let them ride bareback, and catch their horse in his pasture, let them hook and spear their fish, and shin a post and a tall tree, and shoot their partridge and trap the woodchuck, before they begin to dress like collegians and sing in serenades, and make polite calls."[1]

At fifty-eight Emerson noted that "Holmes came out late in life with a strong sustained growth for two or three years, like old pear trees which have done nothing for ten years, and at last begin and grow great. The Lowells come forward slowly, and Henry Thoreau remarks that men may have two growths like pears." It may be noted incidentally that the son of Oliver Wendell Holmes reads abstruse philosophy for recreation and on the eve of his eighty-sixth birthday handed down an important decision as a judge of the Supreme Court of the United States.

Then there is Herbert Melville, who wrote his masterpiece, "Moby Dick," at the age of thirty-five. "On the imaginative level of 'Moby Dick,' Herbert Melville never again walked," says Lewis Mumford, "he had exhausted himself. . . . the greater part of his manhood he clung tenaciously, like a ghost rattling his chains, to the post in the Customs House. . . . For thirty years Melville was like the dead

[1] Perry, Bliss, *The Heart of Emerson's Journals.* Boston, Houghton Mifflin Company, 1926. P. 357.

man of Poe's whose processes of decomposition never halted. He died twice."[1]

Coleridge likewise had a "tragically brief" creative period. Lowes in a brilliant study of the ways of the imagination as exemplified in Coleridge, has given a glimpse into the concealed processes of growth which underlie the productions of poetic genius.[2] Whether cessation of productive power comes through inherent arrest of growth or by dynamic obstruction of environmental or personality factors, it is evident that there is a significant range and depth of individual differences in the developmental characteristics of adult geniuses.

These differences apply to the whole human family from the moron to the seer. The most striking instances of complete symmetrical arrest are to be found in the former;[3] while the latter retains the gift of growth into old age.

The individual differences noted pertain chiefly to the *span* of mental growth. Other differences express themselves in the *rate* of mental growth. These will receive special attention in Chapter VII, "The Tempo and Trend of Development." Still other differences relate to the *pattern* of mental growth. This pattern is dependent on the level, the area, and the configuration of the components of the growth complex.

These factors of span, rate, and pattern can be studied quantitatively. Even in infancy the individual differences

[1] Mumford, Lewis, *The Golden Day*. New York, Boni and Liveright, 1926. P. 152.

[2] Lowes, John Livingstone, *The Road to Xanadu*. Boston, Houghton Mifflin Company, 1927. P. 638.

[3] I have in my files a collection of letters from a high grade moron who had to be committed to an institution. He has corresponded with me over a period of ten years. The amazing thing about these letters, numbered by the score, is their extraordinary similarity. They furnish a convincing picture of the stereotypy which in some measure is the fate of all mortals as the years advance!

in developmental characteristics which are so marked among adults become evident. The individual growth studies assembled in later chapters suggest the possibility of subjecting the growth complex to early measurement. It will take a vast amount of research before the methods of measurement attain precise reliability, but even now it is possible to demonstrate that the general course and limits of mental growth yield to progressive prediction. Both the theoretical and practical aspects of the problem will be considered in chapters on the measurement and the clinical prediction of mental growth (Chapters XVIII, XIX).

### 7. THE INFLUENCE OF INFANCY UPON THE MENTAL GROWTH CYCLE

What psychodynamic relation does infancy bear to the subsequent stages of the mental growth cycle? On this broad question there are widely divergent views. The homely saying, "As the twig is bent the tree's inclined," points in one direction. A Chinese proverb, "No matter if the twig is bent, 'twill straighten when a tree," points in another direction.

From one viewpoint, infancy is merely a transitional episode in the course of development, with slight influence from or upon any other stage. This theory would regard infancy chiefly as a maturational period in which the mind like the body pursues a course primordially determined. Environment formalizes and gives a superficial pattern to the growth; but it is mainly a process of unfoldment and differentiation which is very much like the embryonic period and furnishes substructure and equipment for later development. Therefore, so the rationalization runs, all infants are very much alike. Do they not appear alike? Later complexes of behavior are supplementary to those of infancy,

but they are annexed, without intimate organic connection. Vaguely this view is often entertained by parents and educators. It is thought that infancy is near the indifference point, and that the significant individual differentiations arrive with later childhood and adolescence. Similarly it has been held that infancy is too near the zero end of the scale for the manifestation of measurable differences. Such attitudes lead to the benevolent generalization that all infants are indeed quite alike, and that infancy is a stage which is left as much behind as the rungs of a ladder after the summit is reached.

In sharp contrast is the view that infancy projects itself into all the later life stages and helps to determine their very architecture. The most vivid expositions of this theory of infancy are to be found in the literature of psychoanalysis. In general this literature gives infancy a strong reference both forward and backward, and builds a bio-historical interpretation of the infant's career. This interpretation supplants the bare categories of stimulus and response, with personalized concepts of the unconscious, the conscious, the censor, the super-ego, and the infantile self.

The psychoanalyist begins with certain assumptions regarding the sources of human behavior. He posits instincts; he establishes *a priori* the psychic dependence and the affective Eden of the foetus. Birth becomes a revolutionary event which lays the foundation of future feelings of anxiety, or even produces such feelings in the newborn infant. The growth of the infant is determined by the "libido" which is the source or impelling essence of his mental life. The libido is derived from the needs of the individual and of the species — hunger and sex. The study of the infant's mental development must portray how the energy of this libido is distributed, how it reacts to the

vicissitudes of environment to preserve both the satisfactions of the ego and the needs of the race. If the distribution of this energy is expedient, balanced, and ordered, we have normality; if not, abnormality. The difference between normal and abnormal individuals is not so much qualitative as quantitative and relates to this very matter of the economy of energy distribution. The difference also hinges on the mobility of the libido, and the success with which it meets ascending life issues. In the refractoriness of the libido as it is brought against the ascending treads of the stairway of social life is an index of the healthfulness of the ego.

The purpose of this sketchy and inadequate characterization is to indicate that the psychoanalytic concepts of mental development preserve and emphasize the psychodynamic importance of infancy in adult behavior. The adult is actually derived from the infant, in so far as certain basic modes of conduct, modes of meeting life issues, are established in the first years. To this degree the infant becomes father of the man.[1]

For contrast one may accordingly formulate two antithetical views on the psychogenetic significance of infancy: (*a*) that infancy is a transient phase, which is eliminated in the course of development and therefore relatively inconsequential: (*b*) that infancy is the formative period, when the basic and enduring organization of personality is accomplished. Between these two extremes there is room for a wide variety of postulates and methods of investigation. Indeed, it is probable, from the very nature of present day science, and the complexity of the problems involved, that

[1] A revealing autobiographic account of the infantile origin of an adult phobia may be found in W. E. Leonard's, *The Locomotive God*. New York, The Century Company, 1927, P. 434. (Professor Leonard is the author of the distinguished poem *Two Lives*). His autobiographic volume contains a large amount of analytic data on the development of a marked phobia.

the interpretation of infancy will be shaped by no single school of thought, but will be the outgrowth of a multitude of researches in laboratory and clinic.

The value of bold, dynamic postulates lies in their insistence on the interdependence of visceral, sensori-motor, and symbolic behavior and the bionomic integrity of the individual. But such interpretive concepts surely need the criticism of experimental method and the tempering influence of parsimony of hypotheses. It is in the diversified field of psycho-biology that the wider scientific invasion upon the problems of human development is most promisingly represented. Here, as already indicated, the phenomena of growth and behavior are studied in amoeba, amblystoma, ape, and man in order to define the basic physiology which underlies all manifestations of individual development. Clinical and anthropological research is increasingly adopting the experimental outlook of biology and the quantitative methods of biometry. The biological sciences have in the past century given us an illuminating interpretation of the evolutionary stream of life — the meaning of man as a species. During the ensuing century they may furnish comparable insight into the detailed laws of human growth, — the meaning of man as an individual.

Although we cannot say to what extent the infant stamps and makes the man, we may safely believe that the more fundamental life characteristics of the early ontogenetic stages will also be found in the late stages. The infant grows, the child grows, and also the youth and the adult. There must be some essential continuity in this growth. The growth characteristics of the infant must therefore prefigure in some ascertainable manner the growth characteristics of maturer years and even behavior traits of those years.

The present volume will focus on the characteristics of growth in the normal human infant. There will be an incidental discussion of infrahuman infancy, and frequent references to atypical and exceptional forms of development; but only for the purpose of suggesting the laws which underly all manifestations of growth.

It is assumed that growth *is* lawful and in no sense whimsical, fortuitous, or even wholly unpredictable in its nature. Although we have supplied many charts and tables, it is hoped that the reader will regard them not as literal finalities, but as efforts to express the import of the data. The actual facts of growth are so complicated in their unity that new mathematical and graphic devices will be needed to formulate them.

How can one represent even figuratively the complex process of mental growth? Is there any image, or diagram, which will help us to envisage the ordering of the innumerable manifestations which we call, confidently enough, the growth of the mind? Shall we think of a tree with its roots, its trunk, its branchings, and its foliage? Like the oak, the mind too develops from a seedling stage and undergoes elaboration. And as a figure of speech the tree does carry connotation. Burbank called the child a human plant; and Froebel's hybrid word "kindergarten" also is botanical. The literature of the pedagogy of the child mind is full of expressions which are borrowed from horticulture.

But after all the tree is an oversimplifying analogy. We may section the trunk of a tree, and ascertain its age by counting the annular rings. The human mind does not grow by such process of annular accretion; nor does it grow merely by a process of forking and extension. It preserves a unity more profound and interpenetrating than that of the tree. A tree is at once its past and its present. In its structure we

find a virtually complete embodiment of its whole existence. In the mind, too, past and present are combined, but in a different way. Mental growth is a constant process of transformation, of reconstruction. The past is not retained with the same completeness as in the tree. The past is sloughed as well as projected, it is displaced and even transmuted to a degree which the anatomy of the tree does not suggest. There are stages, and phases, and a perpetuating knitting together of what happens and happened. Mental growth is a process of constant incorporation, revision, reorganization, and progressive hierarchal inhibition. The reorganization is so pervading that the past almost loses its identity. Where is the mewling infant from whom the school boy with shining face is descended? Has the infant mind been snuffed out by the weight of accumulating years; has it become encapsulated; does it lie hidden under higher and thicker strata of maturity? Is growth a process of dying as well as of development? But how do life and death strike their bargain in this drama of development and what factors, what principles, determine survival in the ceaseless competition of organ systems and behavior plexures?

There is no answer to these questions; but there is at least a path that leads to the answer, — a study of the ways of early growth.

# PART ONE

# THE OBSERVATION OF INFANT DEVELOPMENT

# CHAPTER II

# THE CONTROL OF DEVELOPMENTAL OBSERVATION

## ARRANGEMENTS FOR THE SEGREGATION AND MANAGEMENT OF OBSERVATION

### I. GENERAL CONSIDERATIONS

The technique of observation of infant behavior is not a subject which lends itself to free and easy generalization. Nor does the question, What is the best technique? permit a simple answer. Observation methods must vary considerably with the age of the infant and, of course, with the objectives in view. Experimental observation, with conditions so clearly defined that they can be duplicated and so delimited that only a single variable remains for study, is, scientifically, a goal to work toward. But this goal is so very remote that less perfect methods must be used to make any advance at all in mapping the complicated field of mental development. Even the niceties of instrumental technique must be supplemented by qualifying interpretations of factors beyond investigational control.

Moreover it has been argued that we must not only control the external conditions of observation, but we must control the infant himself. The ordinary infant, it is urged, has been moulded by so many unknown and careless domestic influences, that information in regard to him will be of secondary value if not actually misleading. To secure consequential data one must rear the infant *de novo* in the more

natural conditions of an all-controlling laboratory! Such an infant, so runs the argument, would give the basic data that science demands for the delineation of the truly normal or optimal infant.

Lacking the specifications for a nursery laboratory of this type, it is unnecessary to criticize the proposal in detail. To artificially create, out of hand, preconceived ideal conditions of infant development is a task more difficult and dangerous than to seek out the natural and the wholesome in existing home life which has some of the wisdom as well as the errors of centuries. The developmental hygiene of the infant involves such a multitude of complicated issues that there can be no field of investigation which less justifies amateur exploitation, apart from medical safeguards. A naturalistic kind of observation of the ordinary homelife of the infant, both under primitive and modern conditions, can still profitably enter into the study of early mental growth.

Whatever his accustomed environment may be, the infant cannot be fully studied as altogether apart from it. The infant as a self-subsisting psychological entity is a theoretical abstraction. He does not exist. The dynamic relationship between him and his parents, to say nothing of his habitual relation to his physical surroundings, becomes part and parcel of his behaving make-up. The assumption that he has a discrete or hormic mind may well be avoided. For scientific reasons the infant must be regarded as a psychophysical unit enmeshed in and reactive to a social environment. His behavior, as a unit, in relation to his environment will then become the focus of observation and the ultimate problem of interpretation.

In all fields of behavior, — postural control, perception, affective response, language, — the total child accordingly should be kept in view, and his reactions envisaged as dynamic

end-products of the adaptation of his entire organism. Thus we may correct the limitations of topical test procedure and the error of looking only for what we expect to find.

The study of mental growth involves special procedures of observation and record. Growth as such cannot be observed with immediacy. Its movement is too subtle to be caught on the wing. It is a process which must be interpolated between two stages. If the stages are too close, as in immediate perception, the process is not apparent; if they are too widely apart it also vanishes from view. To some extent, then, the methodology of the observation of growth depends upon adjusting the durational interspaces between cross-sectional surveys of behavior levels in such a way as to yield a picture of the course of development.

All science is in a sense descriptive. Surely genetic psychology, like embryology, must rest upon a delineation of structural characters. Even the dynamics of development must be construed in relation to a basic morphology of the evolving patterns of behavior. Such delineation will require systematic, serial comparison of the cross-sectional views of the total growth complex.

We begin with empirical description, but by bringing successive crops of data into organic comparison, we may pass over into interpretative formulation of "laws" of growth and emergence. The facts of emergence must be studied from both a negative and a positive angle, with regard to the dissolution or disappearance of characters as well as the acquisition of new traits. The mechanics of growth are to be sought in this substitution of traits as well as in mere quantitative accretion. Our problem is to define what is permanent, what is projected into the future, and what is transient. The competitive tendencies in growth, that is, the rivalries of alternative tendencies, also need attention.

Figs. 1, 2. — The nursery room for mother and infant. In this room the mother and infant make their initial adjustment to the clinic. They may remain an entire day. The arrangements permit naturalistic observation The Guidance Nursery (shown on the adjoining page) serves for the observation of children over one year of age.

Figs. 3, 4. — Guidance Nursery interior.

Figs. 5, 6. — Outdoor play arrangements of the Guidance Nursery.

Only in this way can we get any new light on the over-conventionalized problem of inheritance and environment.

Although these general considerations are rather theoretical they will inevitably influence the lines and modes of observation. If they are valid they mean that all restricted data of segregated aspects of the infant's behavior must be interpreted with great caution. All specific observations, even under highly experimental control, need to be checked and balanced by naturalistic or clinical observation. It cannot even be granted that certain neuromuscular reflexes of the very young infant are so highly mechanistic that they are quite independent of fluctuating conditions of the total organism. An integrational factor equivalent to, or continuous with, personality must be postulated even in the neonate to preserve completeness of observation.

No one type of observation can displace another. Naturalistic or clinical observation on one hand and experimental observation on the other are not mutually exclusive. All observations are acceptable if they are sufficiently accurate and systematic to lead to clarification of the phenomena. Genetic phenomena, however, are so bewilderingly numerous that science will ultimately place its greatest premium upon quantitative determinations which will expeditiously express the rate and trend of the developmental complex. This complex, in spite of its intricacy, is so profoundly unitary and self-conditioned that predictive indications of its character may be sought in the early chapters of the infant's biography.

The unitary nature of growth does not, however, simplify the technique of observation. On the contrary it necessitates a special degree of coördination of observation. Growth phenomena, because of their integrated inclusiveness, go beyond the scope of a single observer or a single method.

The task is to bring various aspects or manifestations of growth into correlation. This calls for coördination of observation and for a coöperative organization of research.

During the past year the Yale Psycho-Clinic has been granted a subvention which will enable it to take a step in the direction of coördination of investigation in the field of infant development. Although most of the data of the present volume were gathered by individual studies prior to this extension of the program of the clinic, it seems desirable to incorporate here a description of certain observational methods and devices which are now under development. The accompanying photographs will help to keep this description concise. More detailed reports will naturally follow in later publications.

## 2. SEGREGATED OBSERVATION WITH ONE-WAY VISION

There are many kinds of child observation which are scientifically best served by isolation of the observer. Whether the child is to be observed alone, with his parent, or in social response to another child or to a whole group of children it is desirable in certain experimental situations to have the recording observer entirely out of the behavior picture. We have found that a small glass window cut into the panel of the door of an observation room is both convenient and useful for a single observer. There are, however, many situations in which more adaptable and versatile arrangements are needed.

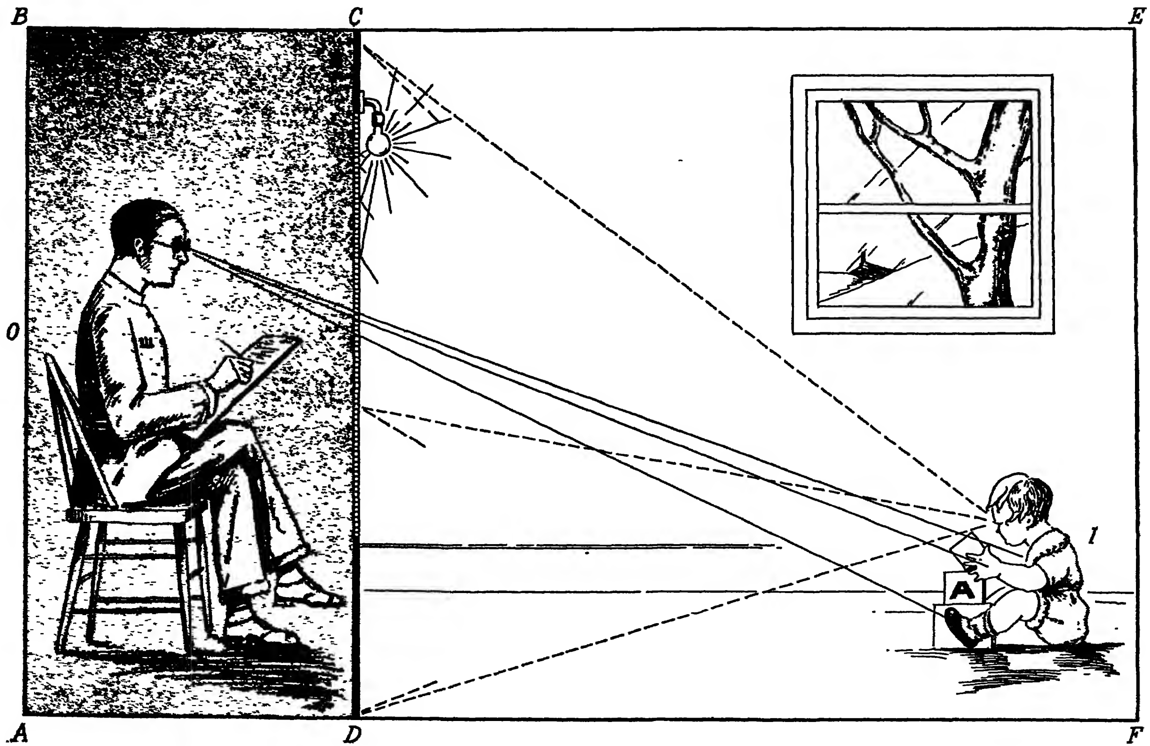
The multiplication of nursery schools which are used for demonstration and teaching purposes has created new problems in the management of observation. Groups of eager, note-taking observers station themselves in the nursery or mingle with the children. Frequently the rela-

tions permit free physical contact with the visitors, and when conditions are not controlled the child suffers from well-intentioned but too familiar intrusions. When these difficulties are recognized they may be regulated, and it must be granted that young children adapt themselves to a considerable degree to an observing gallery. But at least these informal arrangements do not meet medical and scientific standards of control.

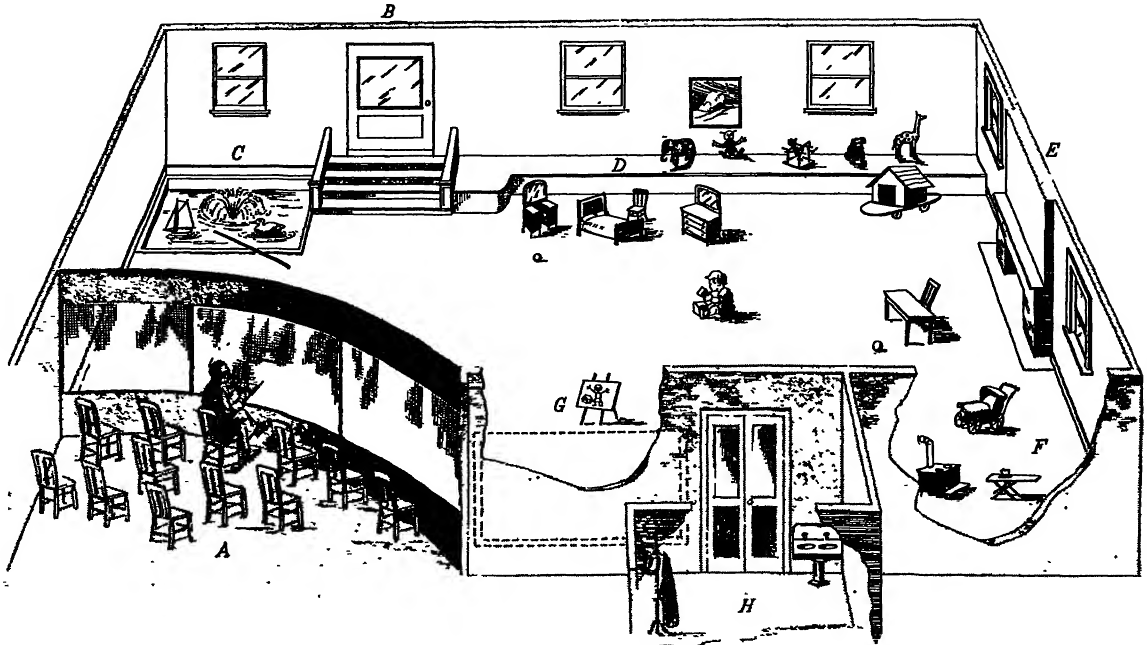
"Education," said Emerson, "begins with respect for the child." Observation of the child begins at the same point. For this reason it seems to us necessary to find ways of preserving the optimum naturalness of the child and of protecting him against undue encroachments from the inquiring adult. The cloak of invisibility of the fairy tale would best satisfy this acknowledged need. Our nearest approach to such a fabled camouflage is the device described below. This device has been put to practical test in the photographic laboratory and in the guidance nursery of the Yale Psycho-Clinic and has proved itself adapted to both individual and group observation.

The principle of the method is a simple one, and is illustrated in the accompanying diagram (Figure 7). The observer (O) sits in the observation station (ABCD). The infant (I) is on the floor of the main nursery (ABEF). A sixteen mesh wire screen separates the observer from the infant. This screen functions as a visual sieve permitting one-way vision only. It segregates the observer so completely that the child is not aware of his presence. On the other hand, for the observer, the screen is a window through which he can observe with ease even though he may be seated several feet from the screen itself.

These properties of the screen are due to both physical and physiological factors which are briefly indicated by



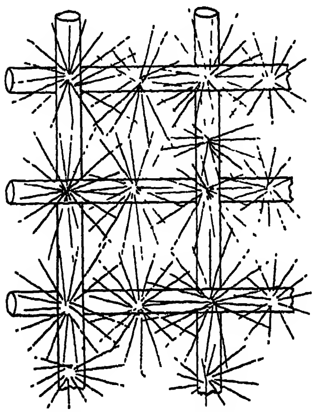

(Fig. 7. — See legend below Fig. 8.)



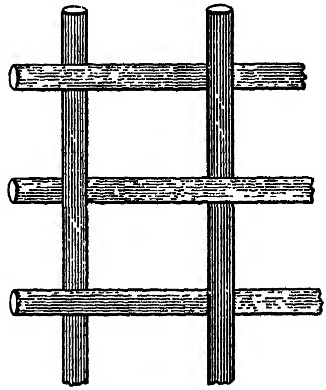

Figs. 7, 8. — Device for segregative observation in the Guidance Nursery of the Yale Psycho-Clinic.

The observers (*O*) sit in an alcove represented by *ABCD*, in the upper diagram (Fig. 7) and by *A* in the lower diagram (Fig. 8). The infant (*I*) is on the floor of the nursery *ABEF*. A 16 mesh wire screen separates *O* from *I*. It functions as a visual sieve permitting one-way vision only.

Figure 9. The interior surface of the wire screen which confronts the observer is of darkish metal hue. The exterior surface of the screen which confronts the child is a bright



A- *External aspect of Observation Screen*



B - *Interior aspect of Observation Screen*

**Fig. 9. — This diagram illustrates the optical characteristics of the segregative observation screen.**

**Sketch A shows the external aspect of the screen, which is luminous on account of its white enameled surface and because of the illumination of the field which the screen faces. The light rays fall on the cylindrical wire and are reflected and re-reflected by the curvature of its surface. This results in a dispersion of light, which obscures the definition of the observers stationed in the darkened alcove behind the screen. The external surface of the screen (A) is therefore perceived as a solid white wall.**

**Sketch B shows the interior aspect, which is unpainted and nonluminous. Light rays from the exterior pass through the meshes and give good definition to the objects outside. The observers, therefore, tend to visually disregard the wire, which gives the screen in perception a transparent, filmy character. The optical results are thus the converse of those noted for the external aspect of the screen.**

white. This whiteness was secured by painting the exterior surface with several light coats of white enamel. The paint has reduced somewhat the size of the meshes and has greatly

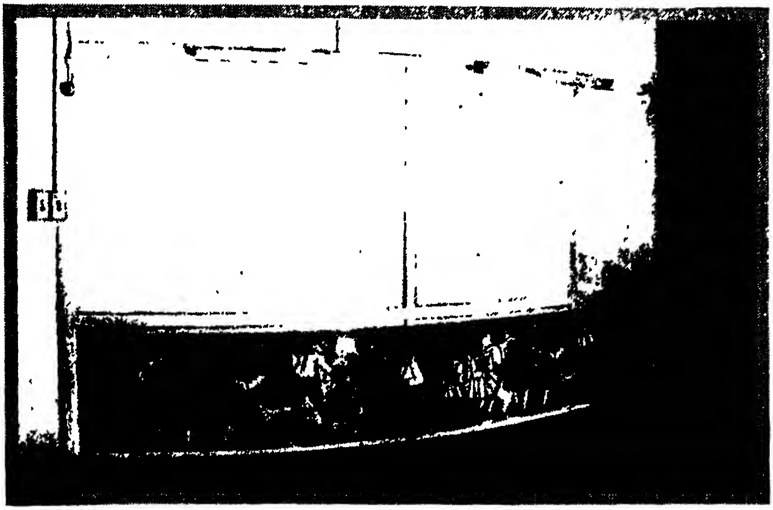


Fig. 10. — Exterior view of the segregative observation alcove. The screen has the appearance of a wall. The observers behind it are invisible.

Fig. 11. — Photograph of nursery taken through the segregative screen by natural light (seven seconds exposure) to show the transparency of the screen.

increased the reflective value of the wire surface. These wires may be regarded as cylinders which frame the mesh openings, as pictured in the diagram. The light from the outside nursery source, augmented by incandescent lights closely applied to the exterior of the screen, impinges on these cylinders and is reflected back by the painted surface.

The diagram suggests the optical effect of these cylinders. The multiple reflecting surfaces, being so near to each other, produce a dispersion of the light so that the beholder on the outside of the screen perceives it as a white, solid, opaque surface. This solidity is due to the diffusion and irradiation of the light, and both child and uninstructed adult entertain the illusion that the transparent screen is part of the enclosing solid wall of the nursery. (See Figure 10.)

For the observer stationed at his post the optical effect is altogether different. The screen appears to him as an expansive gossamer window through which he can readily observe everything that goes on in the nursery. The photograph, (Figure 11), shows that it is possible for a camera to capture a picture through the screen with only brief exposure.

The screen therefore functions both as a sieve and as a valve. The solid divergent lines in the diagram (Figure 7) indicate the observer's field of vision. The broken divergent lines emanating from the infant's eyes indicate the latter's visual field. The light, being reflected back by the screen, gives the infant no perception of the observer, while the perception of the observer penetrates the mesh. In summary, the screen allows physical segregation of the observer and secures a filtration of light which permits him to observe without being himself observed. A mantle of invisibility after all!

### 3. A GUIDANCE NURSERY WITH AN ALCOVE FOR SEGREGATED OBSERVATION

The ground plan of our Guidance Nursery indicates how the observation alcove is architecturally incorporated into the total scheme of the nursery. The foregoing photographs may also assist the reader in the visualization of the physical arrangements. The observation alcove is represented by the curved enclosure (A) in the corner of the diagram (Figure 8). Its approximate dimensions are six feet by ten feet. A dozen observers may be comfortably seated in this space. The interior of the alcove is draped with black denim which serves both to darken the room and to dampen sound. The room is carpeted with a thick carpet to make it still more silent. It is approached by an independent entrance, so that the observers may readily enter the observation alcove without in any way coming to the attention of the child in the nursery. Although there are no windows in this alcove there are no difficulties with regard to either light or ventilation. There is sufficient light to permit note-taking and the screen itself serves as an excellent ventilator. It is practical for a group of graduate students — or parents — to remain in the alcove for any required length of time.

Such a group of students situated in the observation alcove command in their observational field virtually the entire nursery. They have direct view of the main entrance at (B), the play pond at (C), the long low benches (D), which extend down to the fireplace at (E). The domestic corner at (F) and the drawing easel at (G) also come within the range of vision. The orientation of the alcove is so favorable that the observers' chairs do not have to be shifted to maintain uninterrupted observation of a child

who may make swift excursions from one end of the nursery to another.

The main entrance is fortunately located. It is frequently useful to observe the child's initial adjustment to the ordinary nursery situation. This can now be done because the observers are completely out of the picture. The child enters with his mother. His reactions to the new scene may be noted. If he tolerates his mother's absence she may leave and take a place in the observation alcove.

He can then choose among the diverse opportunities of the nursery. The equipment is kept in relatively uniform arrangement so that the spontaneous responses of different children to the same physical situation may be more readily compared. If locomotor interests predominate he may clamber the entrance steps or cruise along or on top of the tempting low bench which skirts the length of the room. Or he may use the bench as a play table and exploit the numerous possibilities of a large, well-stored Noah's Ark on wheels. The ark is part of the standard equipment and the bench is long enough for the entire parade of animals.

The domestic corner may also claim his attention. It is equipped with such house-keeping facilities as a cook stove, an ironing board, doll bed, and doll carriage. Age, and not so certainly sex, will determine his responses to these facilities. A large blackboard and movable easel provide opportunity for free, bold drawing and painting.

The play pond is an outdoor feature which has been built into the indoor equipment. The construction is very simple. It consists of a shallow basin made of galvanized sheet iron seven inches deep, four feet wide, and six feet long. The basin is painted a marine green and is supplied with water from a central fountain. It is attractive to the ear as well as the eye when the water is playing. Miniature

Fig. 12. — The play pond is directly visible to observers in the observational alcove.

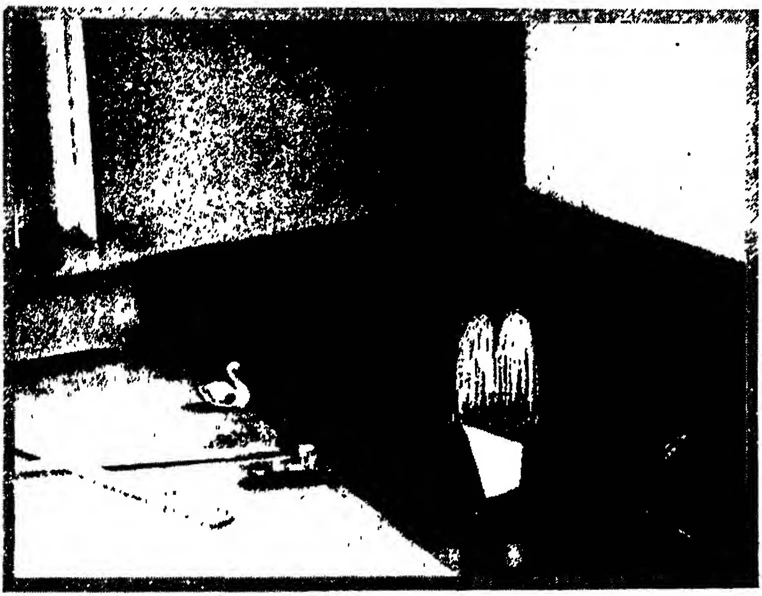


Fig. 13. — The play pond in one corner of the Guidance Nursery.

swans, barges, boats, and other aquatic paraphernalia float on the water. Planks serve as bridges. It is needless to detail the opportunities for exploitation and inhibition. The pond is readily drained and may be used as a drydock for plastocene work and for more conservative play with aquatic toys in movable basins. (Figure 13.)

This simple aquatic arrangement lends itself to numerous uses and adaptations. It is very readily converted into a controlled problem-solving situation which permits experimental observation of tool-using insight. Its close position to the observation alcove adds to its serviceability for psychological work. Architecturally it is a bare suggestion of more elaborate facilities which may well become a part of nursery equipment if the young child's vivid interest in water is of any educational importance.

The nursery is situated in close proximity to the interview and examining rooms of the clinic and to a parent conference room. The nursery may be entered through the cloak room (indicated by "H" on the plan). This room is also equipped with an observation screen and is often advantageously used by the attendant or parent accompanying the child. Through the main entrance ("B" on the plan) the nursery communicates with a spacious lawn and a play shelter provided with sand box, see-saw, sliding board, carts, and other outdoor equipment.

The observation alcove in our guidance type of nursery lends itself to both systematic and demonstrational observation in several different fields which may be summarized as follows:

(1) The spontaneous behavior of individual children, both normal and problem types. (2) The spontaneous behavior of small groups of children. (3) Language behavior in untrammeled situations. (4) Language behavior in controlled

situations involving delayed reaction and other kinds of experimental control. (5) Social reactions between pairs of children. (6) Demonstrations of educational and training procedures. (7) Psychological observation of adaptive behavior under controlled conditions. (8) Naturalistic and comparative observation of clinical problem cases. (9) Clinical demonstration of procedures in developmental diagnosis. (10) Guidance procedures and the parent-child relation.

### 4. INDIVIDUALIZED GUIDANCE AS A NURSERY TECHNIQUE

The observational arrangements detailed in the foregoing section grew out of clinical requirements but have certain suggestions concerning the complicated problems of pre-school education and of nursery procedure. The nursery school movement is now in an experimental and formative stage. It raises many questions concerning the value and limitations of group methods in the education of young children and their parents.

The guidance nursery as outlined has been developed as an adjunct of the service clinic. It is a device for individualized observation and guidance of young children in relation to their parents. It is particularly planned for relatively normal children from one to four years of age, although it can be readily used both for younger and older children and for children with handicaps. A nursery conducted on this clinical and individualized basis naturally has no fixed enrollment. Both the attendance and the activities vary from day to day and week to week. With one clinical examiner and one associated guidance worker intensive work may be done with a score of children and a variable number of parents in the course of a week. Some of these children come individually, others come in small specially organized

groups of three, four, or five. Some children may come once only, with but one follow-up contact; others may come with regularity two or three times a week throughout a portion of the year.

The guidance work is conducted on an individualized dispensatory basis, the procedure constantly varying to meet the specific needs of child or parent. The educational type of nursery school has a regular enrollment; its children attend daily and get the benefit of systematic training throughout the year. Our guidance type of nursery must rely on briefer periods of contact; it reaches numerically a much larger clientele and focuses more directly upon guidance of the parent in relation to the child.

The general procedure may be briefly stated. Developmental examination of the child is made at the clinic by the clinical examiner. This examination furnishes data for an estimate of the child's intelligence and of his personality make-up. This examination, however, is regarded as purely preliminary and is supplemented by a period of observation in the nursery in charge of a guidance worker. The spontaneous behavior of the child under these conditions furnishes important supplementary data for an appraisal of his true abilities and attitudes. This observation leads very readily into actual guidance work and at the same time furnishes a fresh view of the child to the mother who may, from the observation alcove, observe him in the nursery.

A conference of the guidance worker and the clinical examiner leads to the planning of a special guidance program for all children who are returned to the clinic for further attention. It may be decided that a given child will be seen alone two or three times. Or it may be at once determined that the child should be put into a small group of similar age. It may be arranged that an oversilent child shall be brought

into contact with an aggressive child who also is on the child guidance panel.

The number of times a child comes to the nursery is indeterminate and depends upon the amount of adjustment or reëducation which is needed. It seems that we have already demonstrated that with many types of problem children occasional contacts with the guidance unit are effective and that daily attendance is not necessary to accomplish a readjustment. For the most part these children are of prekindergarten age and the facilities of a regular nursery school are available to only a few of them. Fortunately it is not necessary to cling tenaciously to the convention of daily school attendance when dealing with children of a tender age.

The parents, like the children, are for the most part seen individually. The guidance takes the form of a consultation and conference rather than formal instruction. The problems of child management are discussed in terms of the specific child and concretely in relation to his reported behavior and his actual behavior at the nursery. Thus the parent guidance and child guidance are carried on conjointly in a natural context and in direct relation to a concrete situation.

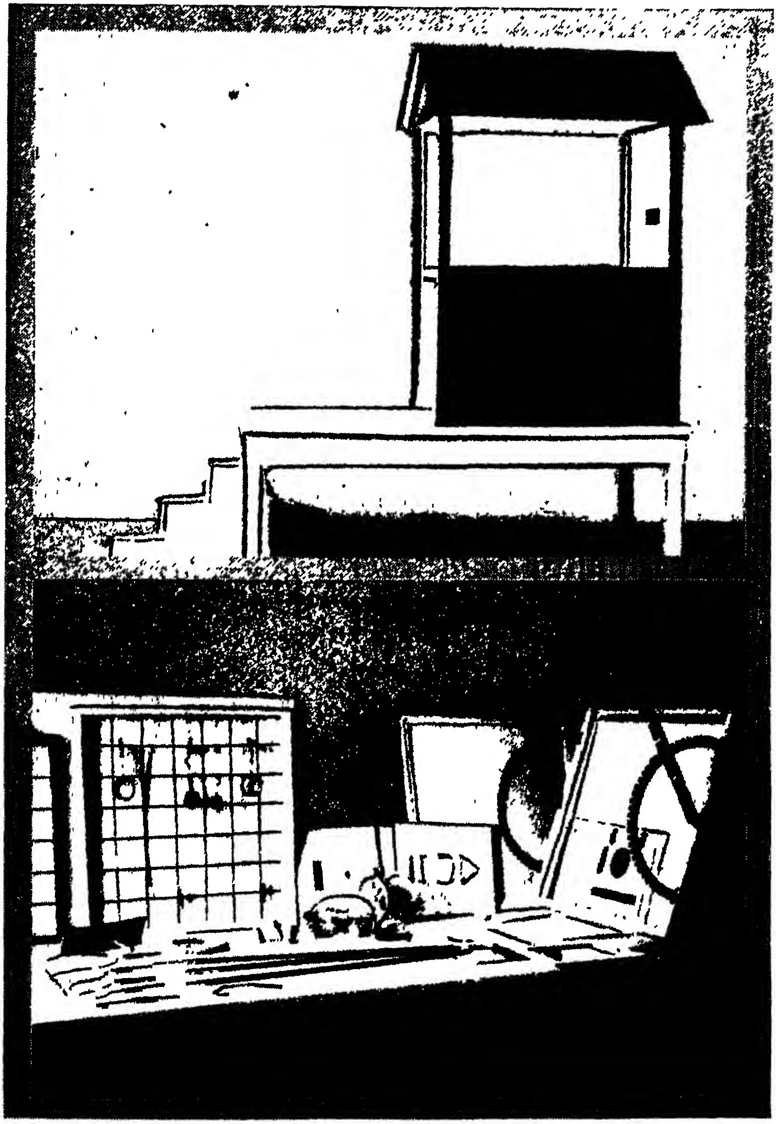
It is evident that in principle these methods of observation and child guidance are simple. They involve no extraordinary equipment. They suggest that the manifold problems of special educational guidance which arise in the home and the kindergarten can be reduced to individual units, and that ways can be found for dealing directly with both the individual child and his parent. It is from this point of view that the method of individualized guidance has significance as a nursery technique.

## 5. AN OBSERVATION COMPARTMENT

The observation compartment which is pictured in Figures 14 and 15 was designed for both naturalistic and experimental observation. It was planned to make this device, in its dimensions and versatility, adaptable to children of all ages up to approximately ten years. Experience has proved that it is suitable for this wide age range and may even adapt itself to older children under special conditions.

The device consists essentially of a cubicle which is four feet high, somewhat over three feet long, and two feet wide. Although planned partly for controlled experimental purposes it was felt that the structure itself should not convey the suggestion of a laboratory instrument. It is therefore decked with a removable gabled roof, which gives the compartment the aspect of a house. Painted as it is in green and red colors, it makes appeal not only to the discerning child but also to the parent. The device is arranged so that it may rest on the floor which is a favorable place for certain types of observation, particularly when it is desired to give the runabout child free access to the environs of the house. For work with young infants its normal position is on a long, white enameled examining table (three feet by six feet) equipped with castors to make it mobile.

This position on the table does not, however, preclude its use for older children. The table is provided with an approach stairway and even the child eighteen months of age may take delight in climbing this stairway to gain access to the open compartment. The child of more advanced age may secure an added thrill by working at the elevated altitude of the table. In this position also, as will be indicated, it is possible to open the floor of the compartment by a cockpit arrangement which permits the child to



Figs. 14, 15. — Psychological observation compartment and apparatus.

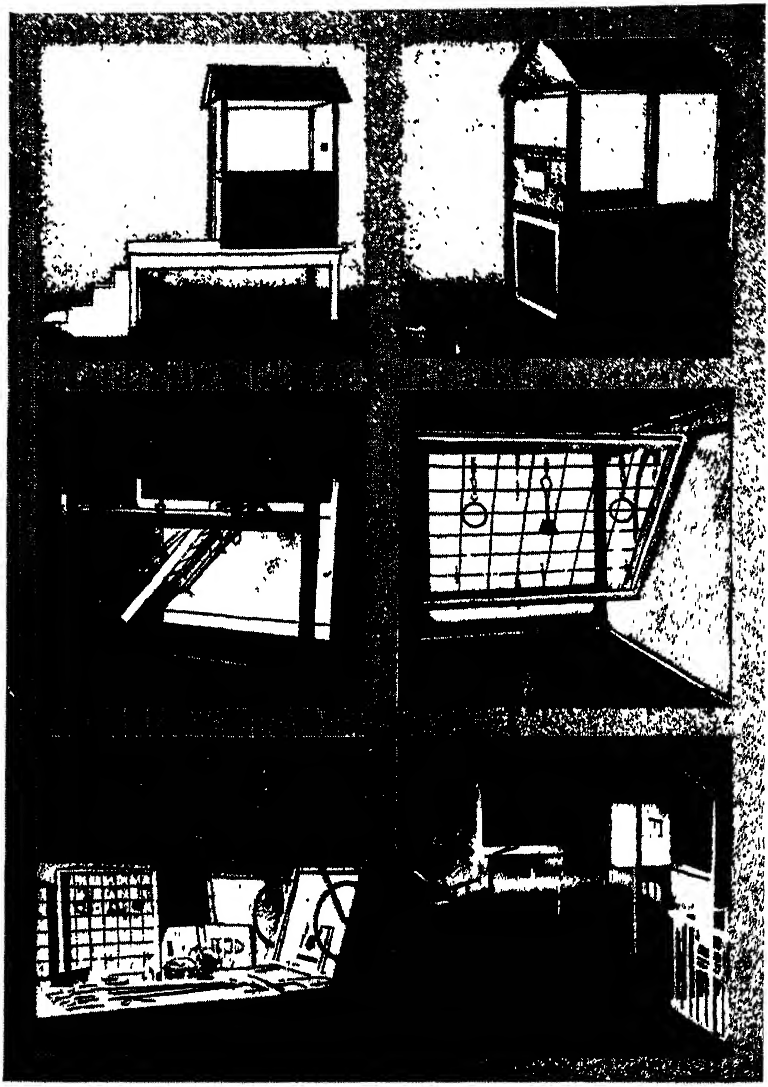


Fig. 16. — Observation compartment and reaction screens showing adjustable and interchangeable features.

deploy his abilities in a downward direction. This possibility has made a peculiar appeal to the children of certain ages.

Since this description is informal, it may be noted here before proceeding to more detailed specifications, that the general purpose of the observation compartment is to release the more rangy and freer body adaptations of the child. When in the compartment, whether seated or standing, the child is not under the restrictions of the conventional performance test situation which is presented to him at a table to which he is confined. As a set-up for naturalistic observation or experimental test it is possible to note the adaptations which the child makes with his whole body as well as the special adaptations which he makes with his eyes and his hands.

As an apparatus the compartment has been planned to permit a high degree of interadjustability and interchangeability of parts. The gabled roof, as already noted, is removable as is the attic floor, which is also the ceiling of the compartment. The roof is provided with removable hooks from which various devices and goals can be suspended. The walls of the compartment are entirely removable so that the structure may stand as a frame with beams and pillars. The walls slide up and down in two parallel grooves so that the compartment may be transformed into an entirely enclosed alcove or a partially enclosed alcove. It may also be converted, through these sliding panels and through a removable entrance casement, into a four-walled house which may be entered by a door on hinges.

The lower inside panel of the compartment is equipped on its upper edge with a brass runway from which various reaction screens may be suspended in various planes. These reaction screens again are interchangeable. They fit into a grooved frame which is swung on a notched brass semicircle

so that the screen may be put in any desired position with relation to the child. Since the side panels are movable up and down, the screen may be raised to an elevation well above the child's head, or it may be lowered to within less than a foot of the table surface. It may also be put in perpendicular or oblique relation to the child.

The reaction screens which may be fitted into this frame are of several types, one of the most interesting being a grill made of intersecting brass rods with interstices three inches square. Since these rods are removable, a grill of any desired configurated pattern may be selected for observation. This type of grill, then, becomes a barrier which separates the child from a remote but accessible object in the compartment and his reactions through the screen may be noted. With infants in the earlier manipulatory stage the bare grill without any additional stimulating objects becomes an effective device for releasing and observing manipulatory reactions and pedal reactions.

Handedness (and in the dorsal position, footedness!) can be readily brought under observation by means of the grill reaction frame. Figure 16 illustrates a simple set-up which we have used. Three suspended bells confront the child in the sitting position. One bell is in the median plane, one is in the left hand plane, and one is in the right hand plane. The child's spontaneous address to and exploitation of this situation gives some clue to the fluctuations and dominance of hand preference at different age levels.

Another type of reaction consists of a plain panel cut with openings and windows of various shapes. Another screen consists of plain canvas. Still another consists of a plain plate-glass mirror. It is evident that with these arrangements a large variety of situations may be devised for observation.

When a reaction screen is removed and the child is given unimpeded room in the compartment the gate at the further end of the compartment may be used as a reaction screen or barrier. The gate may be closed or it may be made to swing on its hinges from any side of the containing casement. It may be made to communicate with a maze. When the compartment is on the floor and the entrance is open, the runabout solutions to which Köhler calls our attention may be observed in infants. Likewise the grilled gate can be used for observing the tool-using behavior of the child.

The threshold of this tool-using ability in the young child is represented by straining, reaching adaptations. A coveted object is at first placed within easy reach of the child and then more and more remotely from him, but still within grasp if he makes certain adaptations of arm and body. From this threshold a very wide range of tool-using situations may be planned. The compartment is equipped with various implemental devices for the observation of such abilities. These devices are illustrated in Figure 15 and may be dismissed with very brief characterization. They consist of ropes and sticks, and jointed rods to which may be attached hooks, rakes, and rings of various shapes and sizes. The jointed rod can easily be made some nine feet in length so that the implemental ingenuity of the child with reference to a very distant yet accessible object may be determined.

It would take us too far afield to discuss the limitations and possibilities of this device. We have sufficient records to indicate that, under carefully controlled conditions, it may be made to yield systematic data. Although especially adapted for testing performance abilities in the field of tool-using intelligence, it has proved somewhat to our surprise, very effective for revealing personality differences. The sensitiveness of even the very young infant to the restric-

tions of the observation alcove is itself an item of much interest. The compartment does not automatically solve observational difficulties. It demands increased regard for details of procedure.

Although the compartment has thus far been used chiefly in the study of normal children, it has frequently contributed supplementary and confirmatory data in regard to defective children who revealed their limitations in an unusually striking manner when their practical intelligence was put to a test by means of its problem solving situations.

For normal children at certain age levels the compartment has proved to be a delightful stimulus to constructive activity. We remember in particular one boy, living in an institution, who was given an opportunity to remain in the compartment for an hour and twenty minutes. Graded tool-using situations were devised and his mental appetite seemed to be whetted with each progressive success. His face beamed from the experience. Finally, however, the noon hour arrived and it was necessary to release him for his lunch. He showed reluctance and definitely stated a preference to remain in the compartment to continue with his solutions. He showed unmistakable interest in experimental activity for its own sake. The coveted object was the exciting goal but was not really an outlet for cupidity, because, having secured the object, he did not utilize it as a plaything but even spontaneously reinstated the problem so that he might once more solve the difficulty.

## 6. A CLINICAL CRIB

The requirements of our photographic research as described in the next chapter demanded a device which would retain some of the features of the observation compartment, but in simplified form. This led to the planning of what

Fig. 17. — The clinical crib in use at the Yale Psycho-Clinic, showing the adjustability of platform, panels, rails, gate, and ladder.

may be called, in distinction, a clinical crib. It is built like an ordinary nursery crib, of tubular iron, and preserves the general aspect of a child's crib. The dimensions over all are as follows: length, five feet; width, two and a half feet; height, four feet.

The range of interchangeability is such that the crib may be converted into an examination stand, into a play pen, or into a play house with roof four feet high. This range of adjustment is secured through a movable and a removable platform. The platform, made of sturdy wood, is light in weight and can be easily lifted and set aside; or it may be placed at any one of five graded heights. In these positions the platform rests on four right-angle brackets which fit into slots in the uprights. The brackets are readily removed and shifted.

The rear end of the crib is permanently closed by upright palings interspaced at three inches. The anterior end of the crib is open, or may be closed with a gateway which is adjustable and may be raised to any height from the floor up to four feet. This gateway is made of iron rods. Its palings also are three inches apart. The gate is removable from its hinges and may be oriented so that the palings traverse either a horizontal or a perpendicular plane. The side panels of the crib likewise are entirely removable and can easily be lifted from the flanges into which they engage.

The vertical rods on which the panels slide are calibrated so that they can be accurately adjusted to a determined height. These same vertical rods carry a rail which may be similarly adjusted at any height by means of a spring push button. This rail may be lowered to within a few inches of the floor or to any height up to three and a half feet.

This pair of parallel rails forms the support for the examining table, when such table is used, with a child either

in the sedentary or upright position. The table is twenty inches wide and thirty inches long. It is marked with light horizontal lines so that the test objects can be placed in standardized positions with reference to the child. The child may stand on the floor in addressing this table or he may be seated on the platform. If he is young enough to need orthopedic support, he may be placed in an adjustable canvas Morris chair designed to fit his anatomy and equipped with a transverse belt to secure his position. This chair is pictured in various photographs at the end of the next chapter.

The examination table is both removable and adjustable. It may be placed at variable distances along the course of the supporting rails. It may be raised to a position above the child's head. It may also be replaced by a reaction screen similar to that which has been described in connection with the observation compartment. This reaction screen is held by a clamp on the rails and may be put in vertical or oblique orientation. The dimensions are so planned that the removable crib gate can be utilized as a reaction screen or barrier grill for the observation of certain kinds of adaptive behavior.

A plate glass mirror is clamped to the head end of the crib. This mirror is concealed by a shade on a spring roller. The shade serves as a photographic background in ordinary situations. The shade is rolled up and down when it is desired to observe or to photograph the child's reactions to the appearance and disappearance of his mirror image.

One inconspicuous and supplementary feature of the crib has proved so convenient that it should be mentioned in conclusion. This feature is pictured in Figure 18. It consists of an elaborate shoe-bag made of grayish broadcloth comprising a score of pockets of sizes suitable to contain the

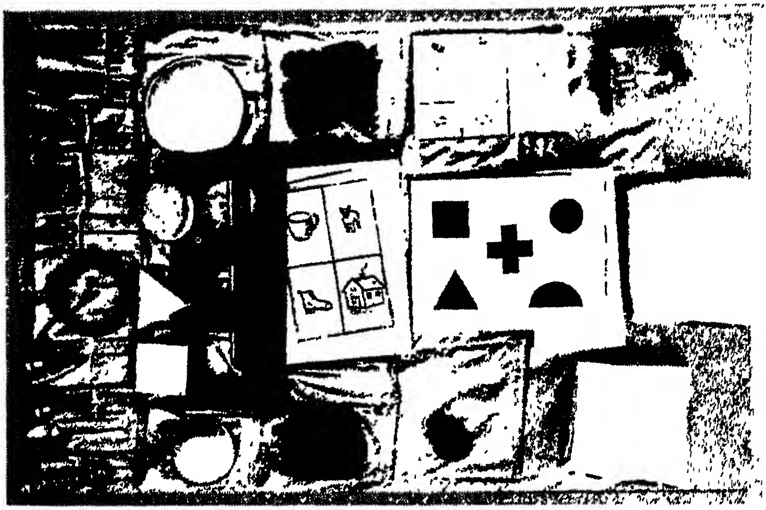


Fig. 18. — Clinical-crib examination bag showing developmental test materials as arranged in pockets.

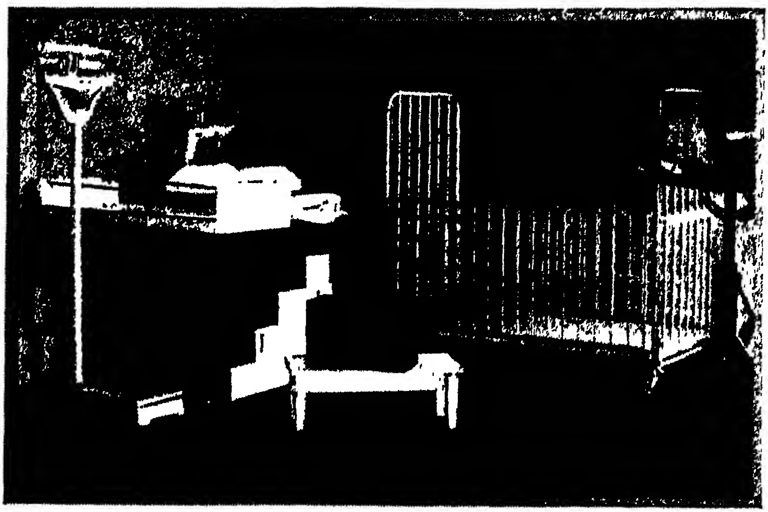


Fig. 19. — Apparatus in use for anthropometric and developmental examination of young children.

various test materials like balls, cubes, strings, pellets, spoon, rattle, etc., used by the examiner. Since these test materials may always be replaced in the same pockets this arrangement serves to expedite and to order the examination procedure. The bag moreover aids in concealing from view the test and play objects which must be removed from the child from time to time. The bag is also useful in connection with the sterilization of the examination materials.

The clinical crib in its present form is especially adapted to the needs of systematic photography. It is, however, also very serviceable in the conduct and control of developmental examinations in the clinic or pediatric ward. A modified version of the present model is being planned for such clinical uses.

# CHAPTER III

# A PHOTOGRAPHIC OBSERVATORY

## A Standardized Dome for Systematic Still and Motion Photography

### 1. SCIENTIFIC USES OF THE CAMERA

The camera has become an almost universal servant of science. In some domains the photographic lens has literally supplanted the human eye. In innumerable fields it has reinforced the investigator's vision and replaced his memory. Many branches of science, of technology, and of art, are now dependent on the remarkable recording retina of the camera, one of the most potent of modern inventions.

The Milky Way has been photographically charted. The mytosis and the phagocytosis of the microscopic cell have been filmed. There is scarcely any important field of visible phenomena which has not been photographed to scientific purpose. Photographic registration has been developed to a high degree in some aspects of experimental psychology, but in the field of genetic psychology the camera has had very little systematic use. The camera cannot, to be sure, photograph growth as such, nor can it afford any direct view of the hidden mechanisms of development. The course and configuration of development, however, are manifested abundantly through overt behavior and this may be photographed instantaneously, cinematically, and in biographic sequence. In quality and in degree the behavior growth which transpires in the first two years of life makes human

infancy incomparably the most dramatic portion of the life cycle. The camera alone can adequately portray and condense that dramatic and kaleidoscopic movement for scientific study. In a previous volume[1] we have discussed certain possibilities of such systematic photography in the charting of child development.

The camera is, in a sense, mightier than the psychological eye. The living eye can see but it cannot record. Not even in the visual arcana of the most eidetic cortex can permanent immutable images be stored for retrospective reference. This is just what the camera can do for us. It can supply seriated optical records — records which do not fade with time nor warp with prejudice, but which perpetuate with impartial fidelity the configuration of the original event.

The first office of the camera, then, may be to record the stages of growth in such a way that they can be brought into progressive organic comparison. The photographic documentation must be conceived in such manner as to preserve significant sequences. Growth is elusive because it is ever changing. The process of change is so subtle that it cannot be grasped by instantaneous judgment. Therefore we may turn to this third eye, the recording eye of the camera, to catch what eludes; to bring past, present, and future together in close compass. The function of the camera is to dissolve the encumbrance of chronological age so that the sequences of growth may be glimpsed in close, spatial juxtaposition without the deteriorating tedium of long lapse of time. With these underlying principles in mind we have undertaken to develop certain possibilities of photography in the genetic study of infancy.

[1] Gesell, Arnold, *The Mental Growth of the Pre-School Child: A Psychological Outline of Normal Development from Birth to the Sixth Year, Including a System of Developmental Diagnosis.* New York, The Macmillan Company, 1925. Chapter XII.

## 2. ILLUMINATION FOR CHILD PHOTOGRAPHY

Lighting presents a problem of peculiar difficulty in the field of child photography. The young child is so active that time exposures are almost out of question. Moreover the aim is to photograph the child in action, but under "natural" conditions. How to preserve this naturalness with artificial illumination was the first problem. Outdoor photography in spite of certain advantages offers little opportunity for standardized regulations. Even an all-glass conservatory would have practical drawbacks in photographic work with infants.

The advantages of artificial light, from the standpoint of uniformity and control, seem to outweigh any disadvantages. The type of artificial illumination to be used was made a subject of special experimental study. Incandescent lights, lamps with special filtering and reflecting features, and arc lights were considered and given trials. Mercury vapor lamps were at first excluded because they called for auxiliary converters to change alternating to direct electric current. These converters were so noisy as to make them undesirable from the standpoint of observational control. This serious difficulty was finally overcome by placing the auxiliaries in the basement of the laboratory and using heavy connecting wire to maintain potential. A minor defect related to the color quality of the mercury vapor lamp. This was remedied by the addition of ordinary incandescent lights which supplied the missing rays.

A battery of eight long, tubular Cooper-Hewitt A.C. lamps with twenty-four fifty-watt incandescent lamps was finally installed in three long, open cabinets fitted into the photographic structure presently to be described. The glare of the lights is entirely removed by tissue paper screens

mounted on a rigid frame several inches in front of the illumination cabinets. One screen is in a secondary reflecting relation to the two main light sources. The curved reflecting surfaces of the photographic structure serve, by reflection and by re-reflection, to augment the light at the central focal area. The clinical crib described in the previous chapter is situated in this optimal actinic area.

The infant in the crib is immersed in a mild, cool, suffused light which resembles sunshine but without its glare. There is no concentrated dominant light source. An ordinary window at his home offers more distraction to the infant than does the dispersed light of this photographic arrangement.

In summary, the light is soft and suffused; steady, noiseless, and cool; it is white and of high actinic value. These features combine to make it favorable both for controlled observation and for photographic record. Illumination is the most fundamental factor in photography. For this reason, we have considered it first and foremost in this report.

### 3. AN OBSERVATIONAL DOME FOR CONTROLLED PHOTOGRAPHY

The second and third requirements of the photographic program called for standardized, versatile control of the cameras and for concealment of the photographic operator. Above all, it seemed desirable to keep the child in isolation from the social, and therefore psychological, distraction of a second or third observer. Therefore, we considered at the outset the possibilities of a standardized alcove which might be approached by a mobile screen, curved and of generous dimensions, constructed to serve as a camera support as well as a concealing partition. We first visualized a screen with a sweeping arc or crane which would make

possible overhead as well as lateral and oblique photography. This conception led to an astronomic type of dome which was adopted as meeting most completely the general requirements. The immediate details of the construction and development of this dome as well as the preliminary

**Fig. 20. — The photographic observatory. The operator and observers are without the dome. The infant is within. The cameras are mounted on two quadrants.**

experimentation with the problem of illumination have been under the supervision of Professor H. M. Halverson, Research Associate in Experimental Psychology.

In a sense the photographic dome is the reverse of its astronomic prototype. The astronomer is stationed within his dome and looks outward to see the celestial bodies. In the photographic dome the route of vision is inward, —

the operator and the observers and the parent are stationed without. Moreover there is segregation of the observer by the same principle which has already been set forth in the preceding chapter. Happily this favors the psychological autonomy of the infant who is released rather than hampered by the physical arrangements about to be described. So far as he is concerned, he is basking in the light of a bright, airy, though windowless, room.

The dome is essentially a hemisphere twelve feet in diameter resting on a circular base which brings the upper curvature of the vault nine feet from the floor. The framework of the dome consists of two camera-bearing quadrants, and fourteen radiating ribs of sturdy T iron (so called because in cross-section each rib is T-shaped). These ribs were bent on a special frame at a local structural shop, to articulate (with the quadrants) into one rigid, hemispherical unit.

This hemisphere rides upon a circular framework of similar construction, also approximately twelve feet in diameter, and thirty-two inches high. This cylindrical base is screwed in fixed position on the floor. The superstructure rotates. It engages the upper rail of the cylinder with wheels, and can be freely rotated, right or left, by hand propulsion.

The walls of the dome consist of panels of white enameled sixteen mesh wire screen, which fit into the curvature of the framework. This screen, because of its optical characteristics gives the outer dome a bright and translucent aspect in spite of the basic iron construction. The screen serves all told three important functions: (*a*) Its light-painted wires and its curved surface heighten illumination by multiplied reflection. (*b*) The fine open meshes permit free circulation of the air and provide such complete ventilation that even the summer temperature of the dome is tolerable.

(*c*) The painted surface of the interior of the screen makes it a visual barrier to the child within and a transparent observatory to the observers without.

The cameras which are directed toward the focal center of the dome move up and down on two quadrants at right angles to each other. Each of these quadrants consists of two grooved tracks upon which a graflex camera (Series C) travels on a wheeled base board. The base board is adjustable as to angulation. By means of a cord it can be pulled into any desired position on the arc of the quadrant. An automatic self-locking device fixes it in position. One of the pair of cameras travels to the zenith of the dome so that a direct overhead picture may be taken of the child below. (See Figure 21). The two cameras can therefore be poised in a wide range of relations to each other at any angle on the quadrant from the horizontal lateral (0°) to the perpendicular (90°). Since the quadrant is part of a perfect circle the camera once adjusted remains in focus for the center at any point to which it may be shifted. It should be recalled that the illumination also remains in the same fixed relation to the cameras so that the photographic conditions are highly constant.

The cameras are operated by electromagnetic controls, the shutters being released either independently or simultaneously by electric switches. The springs of the shutters have been so adjusted that simultaneity occurs within one hundredth of a second. This means that any attitude or action of the child can be instantaneously recorded in any photographic plane from two critical points which are 90° apart on the circumference of the dome. The first camera may be in any position on the quadrant CT; the second in any position on the quadrant C′T′, the focal center remaining fixed at O. (Figure 21). The accompanying

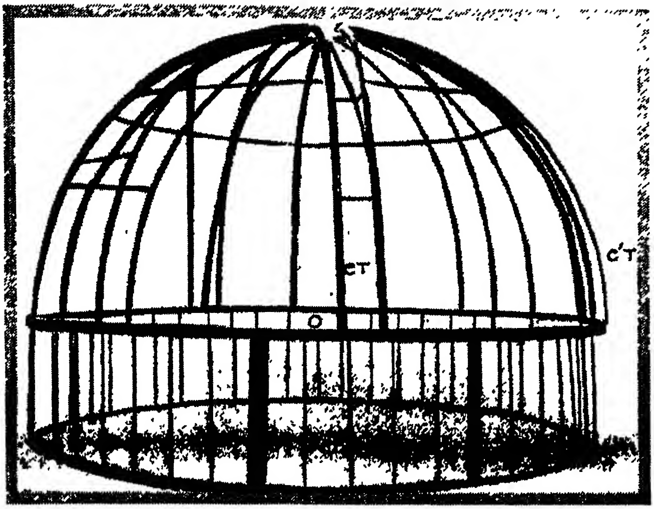



Fig. 21. — The framework of the photographic dome showing the two camera tracks, CT and C′T′, and the universal focal center O.

Fig. 22. Exterior and interior view of the dome showing the white screen panels and the entrance, partly open.

photographs furnish examples of simultaneous right angle registration in varying relations. One picture becomes a supplement and analytical critique of its companion.

In addition to the pair of still cameras, the dome is equipped with two sixteen mm. cinema cameras, which can be operated independently (or in unison) from the two camera tracks. These cinema cameras are mounted like the still cameras on supports which can be fitted into either camera track. Ordinarily only one of these cameras is put in action, being managed with one hand by the operator, who keeps the two still cameras in control by means of the electric switches with the other hand.

This arrangement makes possible a rapid rate and wide range of photographic record. As many as fifty instantaneous "stills" in addition to the cinematic film may be exposed by one operator in the course of one hour of behavior study. Such a pictorial record would consist of (*a*) individual still pictures, (*b*) successive individual stills, (*c*) simultaneous, right-angle stills, (*d*) synchronous motion pictures, (*e*) independent motion pictures. These photographic data, supplemented with stenographic report of the behavior episodes, are filed for comparative study in relation to similar data covering antecedent and subsequent stages of the infant's development. With the later aid of two projectoscopes situated side by side it is possible on the cinema screen to literally bring the infant into immediate comparison with his former self.

Needless to say the value of the photographic records, apart from their content, depends upon the spontaneity of the infant. No effort is made to photograph the behavior of the infant when he is either sleepy or hungry. When extended records are to be made the mother brings her child in the early morning and spends the whole day at the clinic.

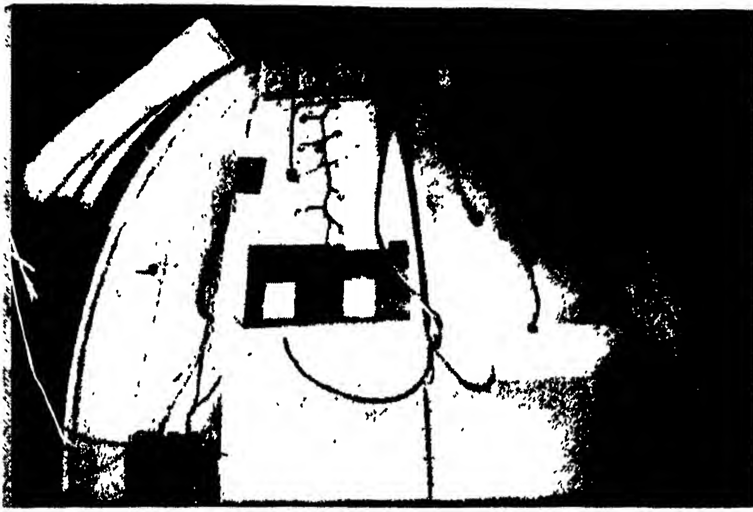


Fig. 23. — Detail of the photographic dome showing the illumination cabinets and wiring for the electric control of the cameras.

Fig. 24. — Detail of one of the camera tracks showing a still and a motion camera in position.

A homelike day nursery room with crib, pen, and other domestic equipment permits the child to pursue his ordinary day's routine under our roof. This gives opportunity for naturalistic observation of his "natural" behavior and for anthropometric measurements when they can be most advantageously taken. At the most opportune moment of his day's routine he is taken to the photographic dome by his mother and by the examiner, with whom he is by this time well acquainted.

The behavior of the infant cannot be truly characteristic unless he is in a favorable relation to his physical and social environment. For this reason the clinical control of these environmental factors is quite as important as the technical arrangements for photography. Accordingly, the observatory has been located near an independent doorway. To the newcomer the dome takes on the aspect of an attractive sunlit playroom or conservatory which is altogether self-contained, and does not permit any inspection of the surrounding laboratory in which the whole structure is placed. The interior furnishings of the dome are confined to the clinical crib and to two photographic roller shades. The mother may, if it is desired, remain in the dome with the child during the observation period. As a rule she prefers to sit unobserved in a chair at the margin of the dome where she can watch her child with comfort.

The reactions of both the child and the parent to the whole situation have convinced us that we have preserved conditions favorable to psychological observation. The simple, sanitary character of the interior equipment and the relative isolation of adults from the child are important features from both a medical and a scientific standpoint. The fact that a number of student observers may gather about the dome without in any way trespassing upon the infant is a

Fig. 25. — Observers and recorder stationed, outside of photographic dome.

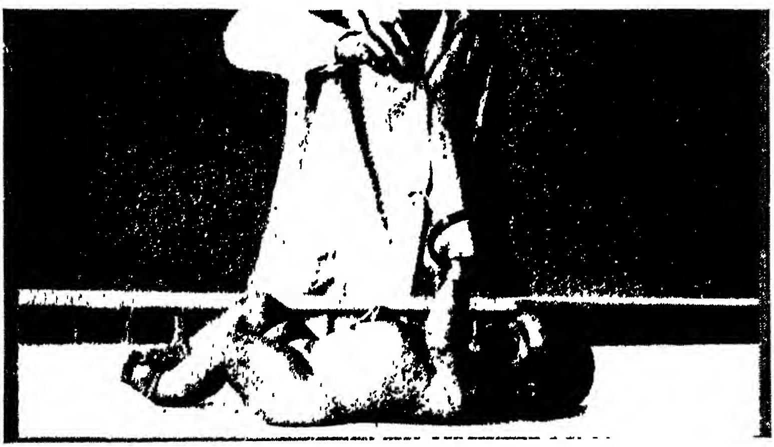


Fig. 26. — The one-way vision screen hides them from the infant's view.

fortunate educational by-product. It is, however, such a real one that the photographic dome may be called an observatory in a double sense. It permits the student, unseen, to observe at close and intimate range; it provides a stage for the all-seeing eye of the recording camera.

### 4. THE COMPARATIVE STUDY OF PHOTOGRAPHIC DATA

The camera records. It does not in any sense displace observation. Indeed, it makes new demands upon the observer who can not escape the task of reviewing what the eye of the camera has mechanically received for his critical study. The analysis of systematic photographic data constitutes a particular field of observation with its own peculiar problems and technique.

No attempt will be made in the present volume to consider these interesting problems in their detail. It is sufficient to indicate that the chief instrumental value of the camera for genetic research lies in its power to produce materials for *manipulative observation.*

The human mind is so limited in its operation that it can perceive and judge the brief instant but not the long sequence. Memory does its best to make amends, but with dismaying distortion and deterioration.

The photographic film, and notably the cinematic film, by its very mechanicality compensates for these defects. The film does not fatigue; what it records remains. By projection the behavior record can be revived at any time and any number of times. It can be revived in part or in entirety; at a slowed rate or a speeded rate and even in reversed eventual order; any moment of the sequence can be halted for separate scrutiny; any phase can be repetitively revived *ad libitum.* These properties of the cinema are familiar but they have special significance for the technique of genetic ob-

developmental data of the

camera into a manipulative form for systematic comparison.

This fact may be illustrated in a concrete behavior episode like the prehension of the pellet. The camera records this behavior under the standardized conditions of the photographic observatory in one child or several children somewhat as follows:

Age V months: Transient visual regard for the pellet.

Age VI months: Rakes the pellet with flexion of the fingers of pronated hand.

Age VII months: Scoops the pellet with finger flexion and palmar cupping.

Age VIII months: Plucks the pellet with partial predominance of ulnar digits.

Age IX months: Picks pellet with opposition of thumb and index finger, approximating pincer prehension.

The cinema film not only embodies the total behavior episode for each of these ascending age levels but it revives the elementary phases of each organic sequence in a progressive installment form which permits analytic and comparative study. Every durational second of behavior is represented in the strip of film by sixteen separate photographic frames. In projection any one of these may be selected for special attention.

The nature of the photographic data for the pellet behavior may then be represented in formula. The roman numerals below state the age levels in months; the letters indicate more or less equivalent phases of the total behavior event at each age; the arabic numerals denote the individual photographic frames which, discretely, analyze and sequentially reconstitute the original behavior:

V: A 1, 2, 3, . . . B 1, 2, 3, . . .
VI: A 1, 2, 3, . . . B 1, 2, 3, . . . C 1, 2, 3, . . .
VII: A 1, 2, 3, . . . B 1, 2, 3, . . . C 1, 2, 3, . . . D 1, 2, 3, . . .
VIII, IX, etc., fall similarly into series.

Comparable data exist for different individuals, John, Jane, etc., in corresponding situations at corresponding ages.

The foregoing symbols serve to emphasize the remarkable mobility of the photographic data. By means of a projectoscope any segment or any combination of segments may be successively inspected (and reinspected) and studied. By means of two projectoscopes any two segments may be brought into simultaneous comparison.

Thus, V: A 1, 2, 3 . . . may be projected on a single screen. In successive series VI: A 1, 2, 3 . . . and VII: A 1, 2, 3 . . . may be projected on the same screen. Or, to magnify the developmental disparity, V: A 1, 2, 3 . . . may be followed by VII: A 1, 2, 3 . . . This will naturally sharpen the contrast. To vivify the comparison V: A 1, 2, 3 . . . may be projected on a left hand screen, and V: A 1, 2, 3 . . . may be simultaneously projected on a right hand screen. Or V may be brought into immediate cinematographic juxtaposition with VII or VIII.

In this sense past and future are absorbed into the present. Since the cinema actually reinstates the original behavior it is possible to bring the six months infant into immediate paired comparison with his past five months self and his future seven months self. The camera to this extent does dissolve ordinary limitations of time and space; and makes for *manipulative observation.*

Genetic phenomena occur in changing orders of magnitude and in changing orders of pattern. There is as yet no absolute unit of mensuration for either of these two spheres of analysis. For this reason the refinement of comparative methods of observation and of normative formulation must remain an essential part of the scientific study of child development. Systematic photography becomes a scientific method when it is used as a tool for comparative observation.

### 5. PHOTOGRAPHIC STUDIES IN INFANT DEVELOPMENT

The following pages assemble specimens of photographs made under the conditions described in the present chapter. These photographs illustrate the technical possibilities of the dome devices for simultaneous, instantaneous, and cinematic photography. The photographs were taken systematically with reference to the advancing age levels of the infant.

The pictures, therefore, suggest characteristic behavior at these representative age levels. In some instances, however, as at nine months, the behavior is somewhat in advance of the average and should not be regarded as altogether typical. The graded photographs will also supply the reader with a concrete point of departure for the ensuing chapters which deal with comparative and normative studies of the early growth of behavior.

The photographs in this section are grouped as follows:

Figures 27, 28: A pair of simultaneous photographs showing the two-way access of the cameras at the horizontal level. (The baby is 7 months old.)

Figures 29, 30: A pair of simultaneous photographs made with one camera at the zenith and the other at the horizon of the dome. (The baby is 6 months old.)

Figures 31, 32: A pair of simultaneous photographs with a 6 months baby in the prone position. One camera was poised at the zenith of the dome; one at the horizon.

Figure 33: Infant behavior at one, two, three, and four months.

Figure 34: Infant behavior at five and six months.

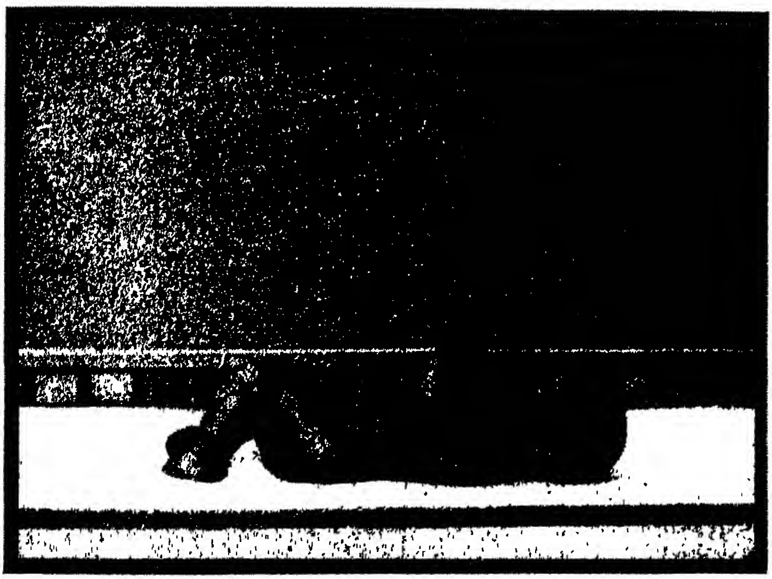
Figure 35: Infant behavior at six, seven, and eight months.

Figure 36: Infant behavior at nine months.

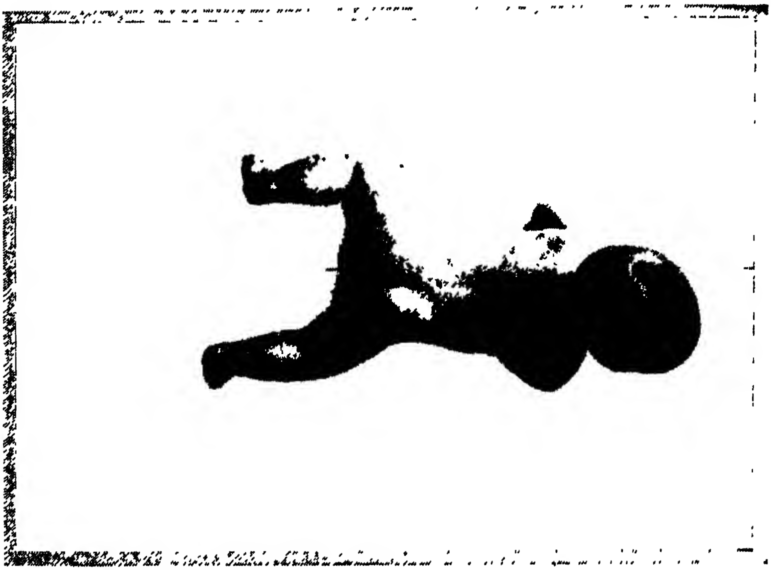
Figure 37: Infant behavior at ten months.

Figure 38: Infant behavior at twelve months.

Figs. 27, 28. — A pair of simultaneous photographs showing the right-angular, two-way access of the cameras on the horizontal level. (The baby is seven months old.)



Figs. 29, 30. — A pair of simultaneous photographs taken with one camera at the zenith and the other at the horizon of the dome. (The baby is six months old.)



Figs. 31, 32. — A pair of simultaneous photographs with a six months baby in the prone position. One camera was poised at the zenith of the dome; one at the horizon.

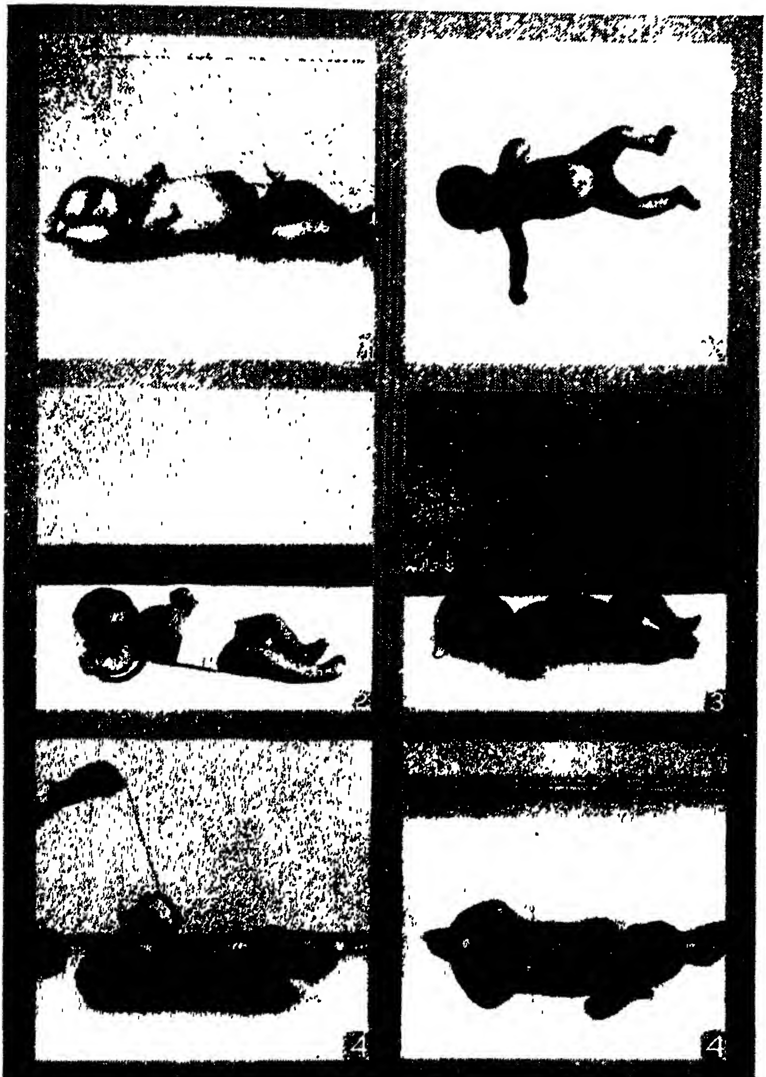



Fig. 33. — One, two, three, and four months.

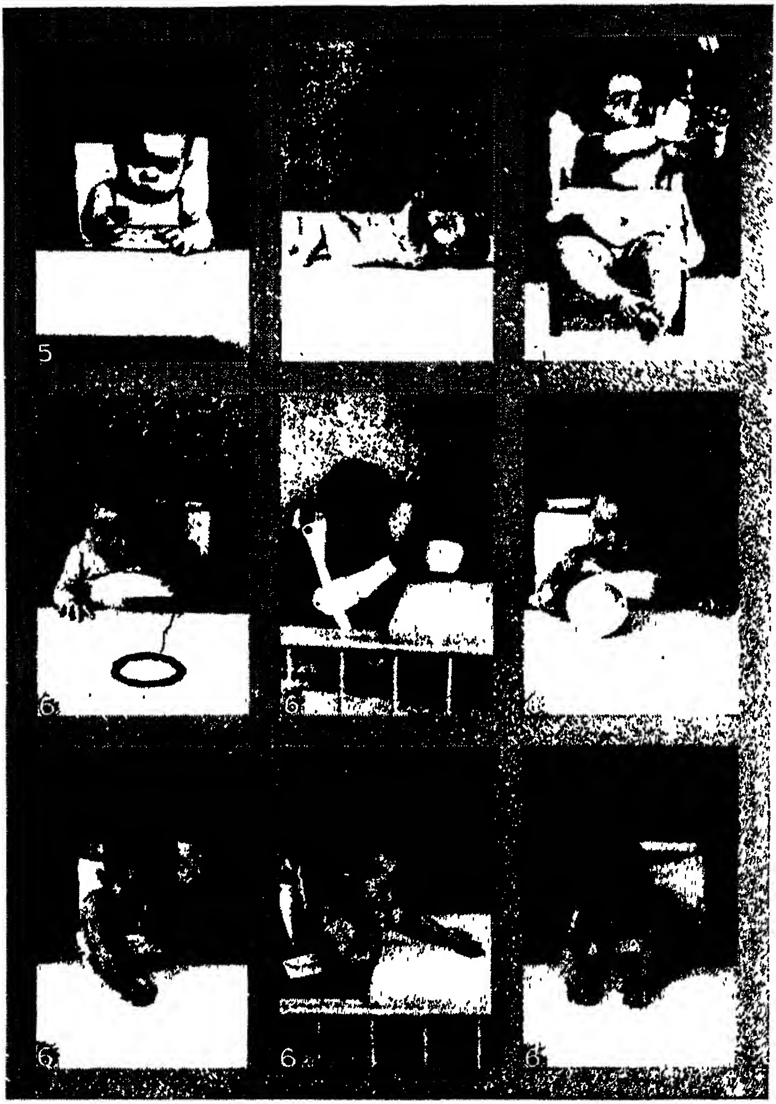



Fig. 34. — Five and six months.


Fig. 35. — Six, seven, and eight months

Fig. 36. — Nine months.

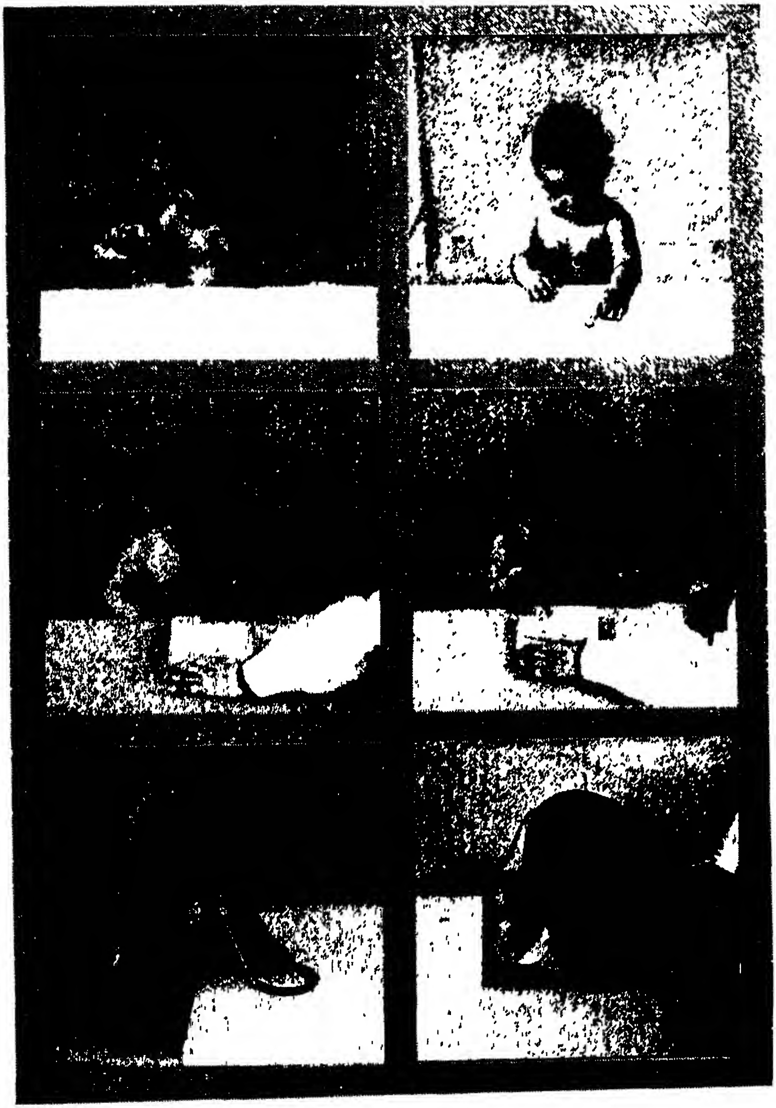


Fig. 37. — Ten months.

Fig. 38. — Twelve months.

# CHAPTER IV

## THE COMPARATIVE METHOD IN OBSERVATION

### A Comparative Clinical Demonstration of Three Stages of Infant Development

The study of infant behavior is not, of course, altogether dependent upon elaborate apparatus. In the present chapter we shift to very simple devices and materials such as were actually used in gathering the data for the developmental studies reported in this volume. The observational equipment used in these studies consisted of a table, a chair, and a kit of sundry psychological materials like small red blocks, paper, crayon, pellet, enameled cup, spoon, ring, and string. Normative, comparative, and clinical procedures were used in the application of these developmental examination materials.

The comparative method of observation is of fundamental import in the field of developmental diagnosis. Its clinical and research applications were discussed in some detail in an earlier volume on *The Mental Growth of the Pre-School Child.* The comparative approach also figures in the present volume and makes it desirable to present a concrete illustration of the method of paired comparison.

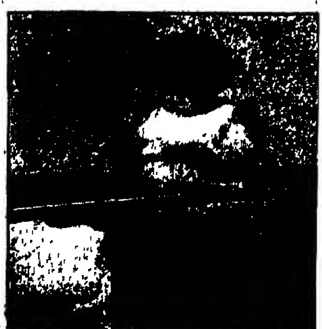
Accordingly, this chapter deals with two pairs of normal infants who were brought into a clinical amphitheater to display comparatively their several repertoires of behavior. The demonstration was planned for medical students in a course in pediatrics to illustrate the applications of the comparative method to developmental psychology and

1 MONTH

4 MONTHS

6 MONTHS

9 MONTHS



12 MONTHS

18 MONTHS

**(Fig. 39.—See legend below Fig. 40.)**

24 MONTHS

36 MONTHS

48 MONTHS

60 MONTHS

Figs. 39, 40. — Ten pre-school levels of development. The richness and rapidity of early mental growth are revealed by a comparative study of these advancing developmental levels.

developmental diagnosis. The comparative pairs were respectively four and six months, and six months and nine months of age. The conditions of the demonstration were simple. Two infants were brought into the clinical lecture room at one time by their mothers. The mothers seated themselves side by side at two small tables with the babies in their laps. Mothers and babies alike made an excellent adjustment to the new situation and afforded a scene which never for a moment lacked pleasant dramatic action.

The spontaneous behavior of the babies was first noted and compared. There was, of course, no odious competition in this comparison because all the babies were thoroughly normal and because their accomplishments and limitations were justified by their ages.

While the infants were thus seated facing the students, group psychologic test material was served to them in duplicate. One clinical assistant was assigned to each child, and the test situations were presented simultaneously in order to bring the behavior reactions of the children into immediate comparative relief.

The convincingness of the demonstration depended, of course, on the actual visible behavior of the children with its mixture of similarities and contrasts. During the course of the demonstration the writer made running comments which were recorded. To preserve brevity and lifelikeness the following account adheres to the stenographic report.

### I. SIMULTANEOUS COMPARISON OF FOUR MONTHS AND SIX MONTHS BEHAVIOR STAGES

The purpose of this demonstration is to show the importance of the comparative method in developmental diagnosis.

A law of contrast apparently controls clinical perception and clinical judgment. It is difficult either to see or to

evaluate symptoms of development as isolated phenomena. They take on definition and meaning only when seen in terms of a higher or lower level of development; that is, in comparative terms.

Systematic comparison is a fundamental scientific procedure. It is of especial value in the elusive field of development. We cannot measure development with mathematical precision, but we may descriptively formulate successive levels of development and we may bring these levels into diagnostic comparison. We may do this whether we are concerned with normal or subnormal manifestations.

Naturally our basis of reference is the normal or median child. Our true norms or standards must be sought in a study of the normal. Next week it will be time to see mentally retarded subjects. To-day we shall observe infants who are making normal progress on their developmental journey but who have not covered the same distance. One is two months "ahead" of the other. If you will compare their behavior you will see a discrepancy. That discrepancy is a measure of the difference in their developmental status. Developmental diagnosis deals with just such comparative differences.

Ordinarily the physician diagnoses one individual at a time. Now, however, two are being scrutinized so that one infant can be estimated or measured by means of the other.

*The infants are seated in their mothers' laps without toys or test material to engage their attention. While the infants inspect their new environment their posture and spontaneous behavior are observed.*

You see at once the usefulness of the comparative method of approach because without your willing it, I am sure, your perception is sharpened by the fact that you can bring two

infants into simultaneous comparison. You observe a certain control and poise in the senior infant (aged 6 months) compared with the perfectly normal, but wobbling equilibrium of his junior (aged 4 months). This confers a certain aspect of sedateness and poise on the older child which is a valid clinical impression. This more advanced motor control is a behavior difference, correlated of course, with the greater maturity of the nervous system of the older child.

*Each baby is lifted in turn. And then they are placed side by side on the tables, to show the difference in sitting posture.*

If I hold these babies and just lift them in order to get the tension feel, I detect a difference that is motor in character. This is the result of a greater tonicity and reactiveness in the postural control of the older child, who is in fact much farther along in the mastery of the sedentary posture in which students become quite skilled. This baby, if he is carefully placed, will momentarily maintain a sitting posture. This is scarcely possible with the four months old child, and it will be noticed that nature has therefore conferred a little more solicitude on the part of the mother of the four months old child who is a little less ready to release her protective hold. Naturally so, because the baby is not quite so independent as yet. There is a certain nicety in this adjustment of relation between the mother and child which asserts itself all along the growing period in conformity with the increasing independence of the child as he matures.

*The examiner demonstrates a difference in the rigidity of head posture by placing the baby's head between the palms and gently exerting pressure to right and left, and then forward and backward.*

Now there is another item worthy of inspection under certain diagnostic conditions comparable to the one just

referred to; namely, the resistance of the head to lateral pressure and to pressure backward and forward. We have no precise objective measure of this resistance. However, you see that there is a difference in the fixity and rigidity of the head control in the case of two children at this level of development; and since the lack of attainment of postural control of the head is an important symptom of mental retardation in early infancy, this item of observation is well worth considering.

*The babies are placed in the dorsal position and their spontaneous movements are noted. The babies are then placed in the prone position to show the difference in postural response.*

It will be noted that these babies do not disport themselves in just the same manner while they lie here in the dorsal position. There are significant differences in the scope and character of the movements of both arms and legs.

The prone position is worth testing in children about whose developmental status one has any doubt, and it will be noticed that at 4 months there is already considerable capacity in the erection of the head. The 6 months child is still farther along; his shoulders are above the table and one can see the beginning of the creeping posture.

*Each clinical assistant takes a small red ring (4 inches in diameter), suspended from a string, and dangles it before the infant, within easy reach.*

Now something very significant may be witnessed. At 6 months one sees characteristic direct reaching. At 4 months, when the ring is dangled, there is a cruder closing-in reaction in which the coördination is much less under visual control. The directness, the accuracy, and the promptness of response are less. This child at 4 months is really somewhat advanced beyond the average level in this

reaction. He is just at the brink of reaching, and if by happy chance or by casual contact he touches the ring, the reaction is one which simulates reaching, but which is not true reaching. The difference in the perfection between these two responses is very significant from a normative point of view.

*Each infant is now held in a sitting position and brought slowly toward the table until his hands are within favorable range of the edge of the table, or just touch the table surface.*

Perhaps you are waiting for me to perform a test. Well, this is the test. The question is, How do these two babies react to the table surface? A marked behavior difference may be noticed here. The 6 months old child is aggressive. He playfully exploits the table surface and the table edge. The hands of the 4 months old child are rather idle in this situation. You may say he is inhibited by your presence. I think not. I think his failure to exploit the table is due to his immaturity. His neuromuscular mechanism has not advanced to that stage which is characteristic of the 6 months old child and therefore he gives only casual heed to the table surface. If his hands touch the table they are likely to linger there, which itself has some significance. He may sometimes perform in a way that simulates a patting motion, but his present restricted reactiveness is the characteristic behavior observed under the more normal conditions of the examining room.

*The infants are still seated in their mothers' laps, facing the table. A spoon is placed before each infant. The attention of the infants to the spoon is noted. The spoon is then shifted to the edge of the table, and each examiner brushes it from the table, so that the spoon falls to the floor. The reaction of the infants to the disappearance of the spoon is likewise noted.*

Now we are going to test the perceptual reactions of our subjects — the perceptual capacity. You are certain that the 6 months old baby sees that spoon and he is making a reaching response toward it. We also have definite evidence of regard for the spoon on the part of the 4 months old child. We see the regard expressed in the fixation of facial and ocular muscles; but it is a rather transient regard, certainly not the prolonged attention which this 6 months youngster is showing.

We are still dealing with neuromuscular mechanisms, because the whole perceptual process is a motor process as well as a sensory one, and we are also dealing with symptoms of mental adaptation. We have before us an objective difference — a clinical cleavage with respect to attention, when the mental adjustment of the younger infant is compared with that of his more mature senior. It is clinical cleavages like this that we are interested in. We are trying to formulate behavior differences in such a way that they will enable us to record developmental status, descriptively and analytically, and thus take the problem of mental growth somewhat out of its present state of elusiveness.

Now please note the difference in behavior, when the spoon suddenly falls to the floor. The 6 months old baby is transiently aware of the disappearance of the spoon; gives heed, so far as we can infer, to its disappearance. The 4 months old baby may also "miss" the spoon, but in a different manner. Neither child pursues a quest for the vanished object.

We must reckon here in some way with the mechanism of attention, because attention has to do with fixation and surely it has to do with this fundamental quality of projection, or of prolongation of interest which we often call concentration. When we bring in our 9 months old infant

we shall doubtless see a projection of interest which can well be considered as a kind of inquisitiveness into the fate of the dropped spoon.

*One by one, several small disks of diminishing size are placed on the table before each child. The first disk is a large wooden button, 4 cm. in diameter; the last in the series is a small pellet, 0.5 cm. in diameter.*

We come back to the question of perceptual reactions and present a series of disks, graduated in size. This simple test indicates that the size of the stimulus and the age factor influence the perceptual response.

The visual fixation of the 4 months old child is elicited by the larger disks. A reaching response, as well as visual regard, is aroused in the 6 months old child. The 4 months old child does not pick up any disk. The 6 months old child picks up the larger disks with ease, but as we approach the smaller sizes we get into his difficult zones. The typical 9 months old infant can pick up this smallest pellet with fairly adept prehension. At 6 months we get characteristically a visual regard for the pellet and not infrequently a palmar scoop reaction which results in a raking in of the pellet. But we are never very much alarmed or surprised if, under favorable conditions, he fails to make a manual approach on this tiny pellet.

*A piece of paper, 8 by 11 inches, is presented to the 4 months old child and pressed into his hands. A similar piece of paper is presented to the 6 months old child. The difference in the playful activity of the babies with the paper is noted.*

The 4 months old child does not reach for the paper even when it is very favorably presented. That is, he does not actively reach for it. At 5 months we have observed that paper favorably placed in this manner will be attained by the

child. The 6 months old infant seizes it directly. The 4 months old infant, however, will grasp the paper if it is pressed into his hand. Both children "play" with the paper. But the degree and the quality of manual exploitation of the paper are distinctly superior in the 6 months old infant.

Taken by itself, this observation is not of much importance; but, comparatively interpreted, it is an objective item that may contribute to our diagnostic estimate. The 4 months old infant is apparently below the level of the 6 months old infant both in play interest and in play capacity.

"Does your baby play with toys?" we ask the mother of the younger child, and she answers, "No." "Does he play with his hands?" "Yes." He has just begun to hold them up for playful inspection. In this way he is perfecting the neuron connections which bring eye and hand into coördination for the reaching-on-sight which becomes so prominent in the behavior picture at the age of 6 months.

We question the mother of the 6 months old child and find that he plays with toys — a rattle and a rubber doll. He has not, however, acquired any domestic tricks, such as waving bye-bye. These acquisitions, as symptoms of normal development, come somewhat later as we shall see. We must not expect too much; but we may say that, from the standpoint of *norms or standards, the average 6 months* old babe is competent to play with a rattle. Even one such item may have a normative value in constructing an estimate of developmental status.

Summing up, we may say that the behavior of both these babies rates up to the expected level. In actual performance and in the quality of their reactions, both subjects are normal. It has been our purpose to give a clear-cut comparative view of the normal behavior characteristic of two closely adjacent age levels. Only two months separate

these children chronologically. If, however, this 6 months old baby today, under our tests, had behaved consistently like our 4 months old baby, we should have to infer a grave degree of retardation. Constitutional retardation expresses itself early. The time clock is an important factor in determining normality of development. Attained development is a true index of prospective development. Within judicious limits even infants must measure up to certain standards.

## 2. SIX MONTHS AND NINE MONTHS BEHAVIOR STAGES COMPARED

*A 6 months and a 9 months old infant are next brought in and observed in the same comparative manner as the previous pair. Their postural control and their spontaneous reactions to the new situation are first noted.*

The ages of these infants are, respectively, 6 months and 9 months. We might have used the same 6 months old subject as before for this comparison, but it is just as well to have another representative. We may be pretty sure that his behavior will approximate that of his predecessor.

Three months make a difference. It will be noted by the behavior of the 9 months old infant as he is brought into the room that we shall have to be duly considerate of his emotions. We are dealing with a more highly socialized individual. By several tokens he has already shown that his social maturity, his personality, is on a perceptibly higher level. The 6 months old child is sensitive to persons, but not to the same degree or to the same extent as the 9 months old child.

Postural control is definitely more advanced in the older child. The mother is holding him much less securely. In fact, he is maintaining a sort of independent position in the

lap. His head control is more advanced. This may be noticed when he turns his head, as he frequently does toward his mother, as though seeking assurance. But he is becoming rapidly adjusted to his new situation.

When placed on the table, the 6 months old child cannot sit without support. The 9 months old child can.

On the first comparative examination it was the 6 months old child who seemed posturally steady, but now the situation has altered. It is the six months old child who seems to lack equilibrium by contrast with the 9 months old. This suggests the significance of comparative and normative procedures in developmental diagnosis.

*The children are seated in their mothers' laps at the tables. A spoon is proffered to each one simultaneously to elicit the reaching and prehension responses. The spontaneous play with the spoon is noted. The spoon is then withdrawn from the child's hands, is placed near the edge of the table and suddenly brushed from the table onto the floor, to determine whether there is any follow-up interest on the part of either child.*

A definite difference will be observed in the reaching response. The 9 months old infant reaches with more directness, particularly overhead. His reaching is also more unilateral in character; right-handed differentiation is asserting itself. When the spoon is placed on the table he picks it up with perceptibly greater skill. He exploits it more elaborately in play and resists withdrawal of the spoon. He is audibly expressing his "impatience" or his desire to play some more with the spoon. He was quietly content a few minutes ago; but having been keyed up to playing he wishes to continue. A kind of circular reaction is at work.

We promised you a comparison with the 9 months old infant in the fallen spoon situation. Here you have it. The

6 months old infant betrays merely a dim, fleeting awareness of the sudden disappearance; the 9 months old child shows a follow-up interest by promptly looking down on the floor in quest for the spoon.

*A small pellet (0.5 cm. in diameter) is placed before each infant, to note the character of the prehension.*

This simple but rather interesting test clearly reveals the advance which has been made in the prehensory apparatus; that is, in the concealed part of the apparatus, namely, its neuronic organization. In the 6 months old infant there is still a rather crude scooping reaction by simultaneous flexion of the digits and cupping of the palm. In the 9 months old infant there is a more precise pincerlike prehension bringing the forefinger and thumb into opposition on the pellet.

*A small wood cube is offered to each infant; then a second cube, and a third cube.*

You observe that the 9 months old infant holds two cubes with more readiness than his junior partner. He also shows more interest in a third proffered cube. Sometimes the 9 months old child will acquire the third cube, by dropping one in hand, or holding two in one hand, or by a prehensile reach with his mouth. This means, of course, that the scope of attention is widening. In another year this child will take and retain almost as many of these cubes as you can offer him.

*The table is cleared. One of the small cubical blocks, an enamel cup, and later a piece of paper are presented to each infant to elicit spontaneous play behavior.*

You note that the 9 months old child makes a more vigorous playful attack on the table when only the table surface is the stimulus. He also plays more elaborately

with the block and the cup. He shoves the cup back and forth, or brings it up to his mouth, or bangs the block against the cup. At the age of 1 year he may repeatedly place the block into the cup in his experimental activities, but this is quite beyond his powers now.

The range and general character of the playful exploitation of the sheet of paper indicate the greater psychologic maturity of the 9 months level compared with the 6 months level.

One can also detect a greater social maturity in his responsiveness to your presence and to your laughter. You may describe this as greater interest in the social environment. This interest shows itself in numerous ways in his domestic life. He is more communicative than his junior; he is more sensitive to communication; he has assimilated more from his personal surroundings. We ask the mother, "Does he say anything?" "Yes, 'mama' and 'dada.'" "Does he wave bye-bye?" "Oh, yes!" "Has he learned any tricks?" "Yes, he can put a handkerchief over his head when you tell him."

Behavior items like these are good indicators of what is going on in the growth of the child's nervous system. Not only do they suggest an increase of intelligence but a development of the countless social habituations, emotional trends, and attitudes which steadily build up what we psychologically designate as "personality." Mental growth is permeated with conditioning factors. It is interesting to note that this particular 9 months old child is at present so conditioned that he will wave bye-bye to his father, but to no one else.

The differences we note in the behavior of this pair of infants are therefore differences not only of intelligence but also of personality make-up. This comparative view may serve to remind us that there are arrests, retardations, and

deviations in the sphere of personality development as well as in the development of intelligence.

Both of these children have made relatively normal developmental progress; both approximate the normative standards appropriate to their ages. But reverse the behavior; suppose that the senior member of the pair reacted like the junior member. Such a degree of subnormality would not be negligible. It would signify serious retardation of mental growth. All growth is relative and must be interpreted in relative terms. A comparative approach is essential to developmental diagnosis.

# CHAPTER V

# MONTHLY INCREMENTS OF DEVELOPMENT IN INFANCY

## A Comparative Survey of the Progress of Behavior in the First Year of Life

The phenomena of mental development are so complicated that we are compelled to use a comparative method in their investigation. Direct, absolute measurement of the stream of behavior is at present an impracticable undertaking. But it is not impossible to chart the direction of flow and to take soundings at successive times and at graded distances along the bank of the stream. Or, to substitute the figure of the tree for that of the stream, we may take cross-sections of the behavior tree at ascending levels of its growth. Neither the figure of the tree nor of the stream does justice to the organic interrelatedness of mental development, but the idea of the cross-section seems to be entirely appropriate.

### 1. COMPARATIVE CROSS-SECTIONS OF DEVELOPMENT

The comparative method of serial cross-sections is the very one which embryology has used to build up a scientific narrative of physical growth. The sections are made at comparable levels of structure and at successive stages of time. The basic facts of growth are reconstructed from these comparative data. A similar comparative approach may be made upon that progression of behavior events which in ordinary language we call *mental growth*. The basic description of mental growth, indeed, must be a sys-

tematic seriation of typical behavior pictures. Refinement and generalization of such description alone can lead us to a knowledge of the laws of growth, either in the psychological or neurological sense.

The comparative method is proximately quantitative. It lends itself to the relative formulation of increments of development even though absolute units for measurement are not available. The implications and possibilities of the comparative method were illustrated in the clinical demonstration reported in the preceding chapter.

By means of this comparative method we have made a developmental survey embracing nine ascending age levels, — 4, 6, 9, 12, 18, 24, 36, 48, and 60 months. The comparisons were made immediate by bringing adjacent ages into paired contrast. The comparisons became serial by making the senior age of one pair the junior age of the next succeeding pair. Thus, on each of eight successive afternoons a pair of infants were brought into the laboratory for simultaneous observation. The pairs were seen in progressive order as follows: 4 *vs.* 6; 6 *vs.* 9; 9 *vs.* 12; 12 *vs.* 18; 18 *vs.* 24; 24 *vs.* 36; 36 *vs.* 48; and 48 *vs.* 60.

The subjects used in this comparative survey were normal children of similar endowment from English-speaking homes of good average economic and social status. The infants were seated in their mothers' laps, or laid on the laboratory table. Psychological test material was administered to the children in duplicate. It required two clinical assistants, one for each child, to provide this material and to synchronize the test situations. While the reactions were in progress the directing examiner dictated a record of the observed behavior. The detailed results of these comparisons are reported elsewhere.[1]

[1] *Op. cit.* Pp. 231–280.

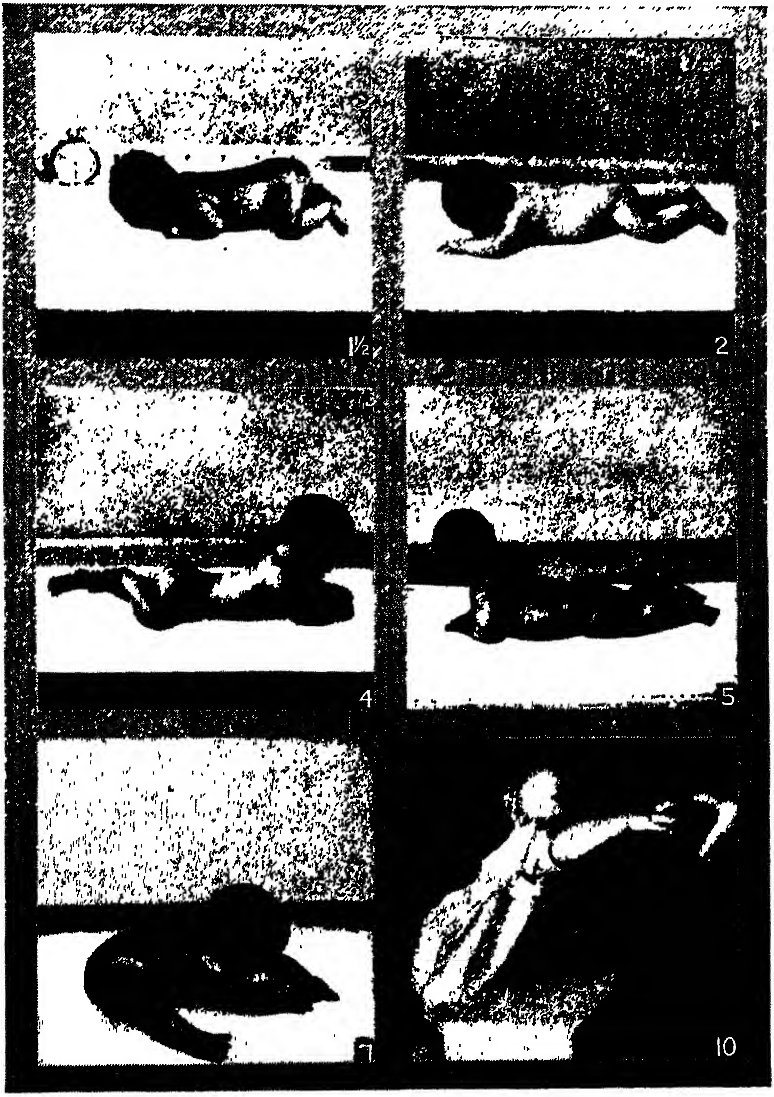



**Fig. 41.** — Small and large increments of postural development from one to ten months. The ten months infant is markedly accelerated in motor abilities.

Our experience with this method led us to wonder whether it could be applied to smaller developmental intervals. What should we find if we brought infants differing by only one month of age into similar psychoclinical comparison? A series of comparisons embracing the first year of life was undertaken. It took not a little trouble to find the subjects separated by just one month of chronological age. With a few exceptions we were able to secure children of the same sex, without siblings, from homes with average standards of child care and of American parentage.

Following the general procedure just referred to, the infants were examined in pairs at ascending age levels. At the 7, 8, 9 months levels and at the 9, 10, 11 months levels three infants were observed for immediate comparison. This made a series of ten comparisons, including in all twenty-two different babies. As far as the practical necessities of the situation permitted, we tried to secure infants of comparable caliber. We could not be overfastidious with regard to this consideration; we can say, however, that so far as expectancy may be based on mother's intelligence, father's occupation, and general quality of the home, the infants are of average or near average potentiality. That we avoided extreme selections is suggested by the fact that in only one instance did a junior infant fully equal or outdistance his senior. The behavior of the 10 months infant was in several respects more advanced than that of his 11 months competitor. The two infants first chosen for the 4 and 5 months levels presented ambiguous or overlapping clinical pictures and were excluded from the series, and replaced by two infants who furnished a more definite behavior differentiation. We attempted to secure "representative" infants because we were interested in indicative rather than critical results. The overlapping just mentioned

is what *a priori* one should expect to find and is itself suggestive of the possible value of monthly norms of behavior.

With the exceptions above mentioned the series of ten comparisons yielded a progressive series of eleven clinical cleavages between the adjacent monthly intervals of development. The cleavages were not as distinct nor as susceptible to formulation as those arrived at when the chronological intervals were very much larger as in the earlier comparative survey. But the cleavages were discernible, expressible, and consistent. In every comparative examination it was possible to report a group of behavior items on the basis of more or less, absent or present, which differences in the aggregate constituted what may be called a developmental increment. By this we mean a behavior discrepancy, based upon objective observation, in which a living subject instead of a calculated norm becomes the standard of measurement. This behavior discrepancy was not based upon a difference in size or bulk. In one instance both babies weighed alike, but their behavior was not alike. In another instance the younger baby weighed forty per cent more than his senior (5 mos., wt. 18 lb. 8 oz. *vs.* 7 mos., wt. 15 lb. 5 oz.) but this physically superior junior was definitely outdistanced in behavior by the smaller companion.

From the standpoint of clinical psychology this is not without significance. It suggests strongly that behavior is a highly sensitive and faithful index of development. The nervous system may well be less affected than other organs and tissues, when "physical" growth is undergoing disturbance or fluctuation. Anatomical indicators may vary more than psychological. The range of variation, for example, with respect to carpal ossification is apparently all out of proportion to the variations observed in the field of normal infant behavior.

Now if the behavior keeps such consistent pace with the fundamental maturity of the child, it follows that monthly increments are ascertainable and worthy of study in the first year of life. Behavior items can be serially graded on a monthly scale; their accuracy can be refined by statistical treatment, and still more by improved technique and scoring.

The 4 months baby, for example, regards a cube on the table; the 6 months baby, a pellet. At four months he picks up a cube on contact stimulus, at six months on visual. At five months he is passing through an intermediate stage illustrated by his ability to recover a rattle which has fallen on his chest.

Items like these defined themselves, sometimes with dramatic clearness, when the pairs of infants were observed comparatively. There were many other items, perhaps equally noteworthy from the standpoint of developmental psychology, which were clinically evident to the observer but resistant to concrete formulation. In our record we limited ourselves to setting down what could be observed at the time, while one infant was actually present and serving through his behaving presence as a comparative measuring stick for his adjacent colleague.

From the rather large mass of observations thus recorded, we cite below in summary form data which illustrate the methods and results of the comparative survey. The excerpts will follow the stenographic report and the infants will be distinguished by their age numerals as names printed in italics: *Baby One* (the 1 month old infant); *Baby Two* (the 2 months old infant); etc. There will be no effort to build up a connected account; but selected observations and comments will be listed in condensed form to indicate items of differentiation between the monthly age levels.

## 2. ONE MONTH AND TWO MONTHS LEVELS

Each child regards his mother's face but there is much less intentness and depth in the regard of the one month child. The eyes of *Baby Two* are open more widely and the facial expression apparently denotes deeper interest and deeper fixation. It would be difficult to secure this observation except for the comparative standard presented by *Baby One*.

When both children are placed in the dorsal position on the table there is a decided difference in the behavior pictures in favor of *Baby Two*. This difference is difficult to describe, but the following factors contribute: Visual regard more intent in *Baby Two*. Number of head movements greater in *Baby Two*. Number and variety of arm movements greater in *Baby Two*. The arm excursions of *Baby One* tend to remain in restricted area and still cling to the body. The range in *Baby Two* is much wider. Knees are less fixed in their flexion than in *Baby Two*. When *Baby One* turns his head to the side it tends to remain in that position longer than when *Baby Two* turns his head in a similar manner.

Mouthing activity is more prominent in *Baby One*. Motor adjustment to being lifted is more pronounced in *Baby Two* than in *Baby One*. It is present, however, in *Baby One*, particularly in the shoulder region. Compensatory head movements are more developed in *Baby Two* than in *Baby One*. When suspended in the dorsal position the head drops down in the case of *Baby One* but retains a position in the horizontal plane in the case of *Baby Two*. When in a similar manner the children are suspended in the prone position with the examiner's hands on the chest and abdomen, *Baby One* erects the head so that it is in the horizontal plane. *Baby Two*, however, erects it sufficiently to make an angle of some thirty degrees with the horizontal.

These distinctions are by no means subjective. They are based upon objective evidence. They are not precise because we have no absolute standard of measurement, but it is significant that they can at least be expressed in terms of more and less. Some of these differences with further investigations can be expressed in relatively accurate terms. From the clinical point of view the important conclusion is that behavior differences in these two infants are perceptible. Even if both infants were of exactly the same size, weight, and appearance, there would be little danger of confusing them because they could always be distinguished on the basis of their behavior differences.

### 3. TWO MONTHS AND THREE MONTHS LEVELS

*Baby Two* is on the whole less reactive to his environment. He displays a lesser variety of motor responses, his motor reactions are somewhat more bilateral in character. *Baby Three* shows more tendency to independent activity on the part of one hand and one leg. *Baby Three* evidently indulges in more varied inspection of his environment. He shows more initiative in turning his head in different directions and undoubtedly makes visual fixation on a greater diversity of objects in the room than does *Baby Two*.

One of the most tangible clinical differences in spontaneous behavior relates to the kind and degree of hand play. Both children indulge in random activity which involves arm, hands, and fingers. Both seize objects reflexively. *Baby Three*, however, has reached the stage of tactile manipulation of objects touched. He retains hold of a rattle for a minute or two at a time. He handles the rattle. Once he shifts the rattle from one hand to the other. This is purely reflexive, but it is significant that his reflex activity has already attained such a high stage of development that this shifting

can be accomplished. He does not play with his hands in the visual-motor way of a four months old child, but he has begun fingering his fingers; that is to say, when his hands fortuitously touch each other he follows up the contact with a simple, manipulatory exploitation.

Both children show a selective interest in the examiner's face as they lie on their backs. There is a tendency on the part of *Baby Two* toward inhibition of reflexes on marked visual stimulation. In *Baby Three* there seems to be increase of activity on such stimulation. This is particularly evident when the red ring is dangled in turn above *Baby Two* and *Baby Three.*

Incipient reaching has not yet begun, but the foundation for incipient reaching is being laid in the increased motor activity induced by the sight of the ring. Emotional activity is greater in *Baby Three* than in *Baby Two.* There is apparently more attention to sounds, although this is difficult to establish objectively.

It is our impression that the emotional life of *Baby Three* is definitely in advance of that of the 2 months old child. He seems to have a more responsive personality and is already showing greater susceptibility to social stimulation. *Baby Two* is given to expression of discontent and discomfort. On the other hand *Baby Three* is positively expressive in pleasurable situations.

When *Baby Two* was compared with *Baby One* he seemed very much more mature than *Baby One.* When *Baby Two* is compared with *Baby Three* he seems as decisively immature. The total behavior picture consistently expresses greater maturity on the part of *Baby Three* just as it favored *Baby Two* in the previous examination. Again the impression does not rest on a difference in physical size but upon a describable behavior discrepancy.

### 4. THREE MONTHS AND FOUR MONTHS LEVELS

Both babies when in the mothers' laps follow a moving person who comes within the range of vision. *Baby Four* however definitely shows more tendency to pursue the vanishing figure, and turns the head a considerable distance in order to keep the eyes on the examiner.

*Baby Four* is much more constantly regardful of persons in the room, and particularly of the examiner, partly because the examiner moves about, but also because of the dictation with its sound and mouth activity. It seems pretty certain that the baby is watching the examiner's mouth movements.

Both babies, seated in their mothers' laps, are slowly brought up to the edge of a long table. *Baby Four* definitely makes body reaching movements toward the table edge when it comes within visual range. *Baby Three* just as clearly fixates on this table edge transiently, but makes no reaching movements toward it. A somewhat significant episode takes place when *Baby Three* and *Baby Four* happen to regard each other at precisely the same time. *Baby Four* smiles definitely and maintains a much longer regard. There is an observable difference with respect to the hand and table reaction. *Baby Three* makes flexion reactions of a reflex nature when the hand comes into favorable contact with the table. *Baby Four* keeps hands on the table for a longer period, and there is a slight element of manual exploitation, unaccompanied, however, by visual fixation. The exploitation depends upon tactile stimulation.

A dangling ring is presented to each infant while in the dorsal position. *Baby Four* definitely regards the dangling ring and hand activity is increased while watching. *Baby Three* definitely regards ring but without any apparent effect on arm and hand reflexes. Repeatedly, however, a

reflex hand and arm response is elicited by bringing the ring into visual field of *Baby Four*. *Baby Three* on the other hand shows a tendency to open mouth when ring is brought into visual field. No such mouth reaction is observed in *Baby Four*.

*Baby Four* makes incipient approach movements to the ring when it is dangled, while he is being held in the upright posture. Twice in succession the child closes in on the ring sufficiently to clasp it. After the ring has been grasped *Baby Four* regards it attentively from time to time and also puts it in his mouth. Occasionally, however, he gives the same regard to his hand when it comes within visual range. When *Baby Three* is offered the dangling ring, also in the seated posture, he regards the ring and opens his mouth in anticipation, but does not approach it in any way. After *Baby Four* has been playing with the dangling ring for a while it is withdrawn suddenly and he shows definite displeasure at withdrawal.

A small hand bell is rung six inches laterally to the ear. Both babies attend to ringing of bell, as shown by facial expression. Neither turns to the bell.

*Baby Three* gives no regard to a spoon placed on the table. *Baby Four* gives definite regard and when favorably placed once makes a sweeping closing-in reaction which gives him possession of the spoon. At other times he follows up tactile stimulation with momentary manipulation. This is manifestly the rudimentary stage which leads up to definite reaching. It represents a higher grade of reaction than is possible for *Baby Three*, and is comparable to the closing in on the dangling ring.

### 5. FOUR MONTHS AND FIVE MONTHS LEVELS

When the babies are brought to the table edge *Baby Five* immediately exploits the new situation, scratching the

table top with his left hand and inspecting and cooing at the same time. He brings his right hand to the table surface and continues to coo satisfaction as he presses against it. The attention of *Baby Four* thus far has been engaged chiefly by his own hand which he inspects in a characteristic manner. Presently he attends to the table for a moment but does not show the same constant and elaborate response to it. He is also easily distracted by the moving figure of the examiner. This does not distract *Baby Five* who is still definitely playing in an exploitive manner with the table edge. *Baby Four* makes faint and fugitive manipulations, but they are very definitely more reflex in character and depend more upon tactile stimulus. There is an element of initiative in the reactions of *Baby Five*. It is now about five minutes since he was brought to the table. He is still playing with it with evident interest, occasionally vocalizing with satisfaction. We shall see how long this interest is continued. *Baby Four* tends to gaze at the window and his reactions to the table are much more casual in character. *Baby Five* is distracted momentarily by a playful approach from the mother, but reverts to the table, handling and scratching it. The hands of *Baby Four* frequently leave the table, but speedily return. It may be said that for fully ten minutes the hands of *Baby Five* have remained in almost uninterrupted contact with the table. He is still playing with the table, but it is our impression that the interest has by this time somewhat abated. Descriptively it is fair to say that his attention span for the table has approximated ten minutes.

A small, red cube is placed on the table in front of each child. *Baby Four* transiently regards it. *Baby Five* fixates upon it for a much longer period; his regard is less wavering.

A pellet is repeatedly placed upon the table in the same manner. Neither child gives visual heed to it.

The babies are placed in the dorsal position on the table and a dangling ring is presented to each. Both give immediate regard to the ring. *Baby Five* even takes his hand out of his mouth to reach for it. The reaching is not accurate but it is prompt and looks purposeful. This is momentarily broken up by a casual contact of the right hand with the left hand. This shows that the reaching ability is by no means well established. *Baby Four* closes in on the dangling ring in a crudely adaptive manner. There is an element of manipulation after he gets hold of the ring. In his play he several times transfers the ring from one hand to the other, due to the alternating character of his manipulations. The closing-in reaction on the ring is not circumscribed. In a sense the whole body participates in the response, the head leaning forward slightly, the legs coming up, and the arms closing in, all at one time, as though it were an amoeboid type of reaction.

When the reaching reactions are compared, it is very evident that the response of *Baby Five* is more direct and more delimited than that of *Baby Four*. There is a forward thrust of one or both hands by *Baby Five* and although the coördination is not accurate it has a prehensory quality. It seems very expert when compared with the closing-in reaction of *Baby Four*. (But on the morrow it may well seem very crude when compared with the reaching of the six months level.)

Both babies have shown excellent poise throughout the examination. *Baby Four* fussed briefly and sputtered once or twice. Beyond this no vocalizations were noted. The vocalization of *Baby Five* was greater in amount and more varied in range.

At the close of the examination, when in the dorsal position, *Baby Five* reacts promptly to play objects like a dangling ring and watch. There is, however, a distinctive response

when the bottle is brought within view. This expresses itself in vocal excitement and smiling and tension of the body and in a vigorous closing motion of the hands. When the bottle is removed there is a protest which, because of the lability of the child's emotional reactions, is immediately changed to a smiling, playful reaction. The playful reaction promptly subsides and is followed by a protest which in turn becomes a vocalized expression of expectant satisfaction when the bottle is restored. This shows very clearly the flexibility and the sensitiveness of the emotional responses of the child at this time.

### 6. FIVE MONTHS AND SIX MONTHS LEVELS

Both babies, after coming into the examining room, show a predominating interest in persons. They turn from one face to another, inspecting. Both babies give prompt attention to a moving figure, and follow it out of sight. *Baby Six* follows perhaps longer than *Baby Five*. Mother reports that *Baby Six* is beginning to be conscious of strange faces, and has on occasion cried on seeing a new face.

A spoon is presented to each child. *Baby Five* seizes it in a crude manner. The hand closes on the spoon promptly on first contact. This closure might be described as being uncritical in character. The spoon gets into all sorts of positions with reference to the hands and fingers, whereas in the case of *Baby Six* there is true prehensory manipulation.

Both react promptly to paper when it is presented edgewise. *Baby Six* manipulates it more variedly and puts it to mouth from time to time. The manipulation of *Baby Five* is cruder, and he is more likely to lose hold of the paper. There is the same difference which suggested itself when manipulation of the spoon was described. The paper edge gets between the fingers in the case of *Baby Five*, whereas in

*Baby Six* the responses are more uniformly of a coördinated, grasping character.

Both children react to a cube when it is placed on the table, and the same difference in motor adjustment reasserts itself in *Baby Five*. The edge of the cube gets between the fingers and there is no coördinated grasping response. The fingers behave like independent, unintegrated units. *Baby Six* however seizes the cube definitely with conjoint flexion of the fingers.

*Baby Six* has a return of timidity attitude and breaks into momentary tears. This is terminated by turning him about face so that he may look at his mother. When seated on the table top *Baby Six* shows somewhat better postural control. Mother appears to hold *Baby Five* more firmly. *Baby Five* will sit for a brief moment when supporting hands are withdrawn. *Baby Six* however sits in this position for a longer time. There is a slow, almost oscillatory motion in *Baby Six* that indicates that the sedentary posture is still in process of maturing.

In the dorsal position *Baby Five* reaches for a ring with the closing-in reaction. In seated posture this reaching is less bilateral in character. *Baby Six* grasps the dangling ring also by closing in of both hands, but the reaction is much less crude and is definitely unilateral. As one hand reaches its goal there is a definite adaptive reaching response.

When pellets are placed on the table *Baby Five* apparently fixates and makes two or three efforts to attain his pellet. The motion is a crude sweeping in without scooping, raking, or prehension. *Baby Six* regards the pellet but makes no active response toward it.

A dangling ring is presented with both children in the dorsal position. *Baby Six* plays with the ring for a few minutes while lying on the table surface. He bangs it occa-

sionally on the table, pulls the string through his hand, shifts the ring from one hand to the other, and exploits it to a degree which is apparently utterly beyond his junior colleague. He loses the ring momentarily because it slips over his arm, and he begins to cry for it. The crying stops as soon as the ring is taken from his arm. He is not able to follow up the ring when it is slipped on his own arm. His pleasure in the ring is not conditioned by the hand to mouth reaction as in the case of *Baby Five*, but consists in the manipulation. Only occasionally does it go to the mouth. He even crows with satisfaction while playing with the ring. Part of his play consists in a rhythmic opening and closing of the hands in which the fingers react in a coördinative manner that was conspicuous by its absence in *Baby Five*. The ring drops and the string is quite enough to engage his attention and interest. When the ring and string are within plain view and only a few inches from his hands he is unable to make the bodily adaptation to attain it.

*Baby Five* is able to play with the ring for some time without dropping it, but the response in quality is altogether different. It consists in a simple rotating manipulation and continuous mouthing. The fingers approach the ring in a cuplike attitude.

### 7. SIX MONTHS AND SEVEN MONTHS LEVELS

As the pair of babies are brought into the examining room they both give immediate attention to the persons in the room and do not regard the furniture. When they are brought to the table *Baby Seven* begins to pat it with his right hand. *Baby Six* is especially interested in persons and appears to listen to and to watch the dictation. Both smile responsively. *Baby Seven* vocalizes more than *Baby Six*. *Baby Seven* occasionally makes advances towards

*Baby Six*. *Baby Six* regards *Baby Seven* with interest but makes no active advances until he touches *Baby Seven's* dress. Vocalization of *Baby Seven* is increased when they play with each other. *Baby Six* crows with delight on seeing leaves waving outside the window. *Baby Six* plays in a reflexive manner with *Baby Seven's* hand but gives chief attention to his face. The quality of *Baby Seven's* reaction is more mature and more social. After about ten minutes *Baby Six* begins to play very actively with the table surface, pounding it in a banging manner. It is significant that this did not begin until after a lapse of ten minutes and until the examiner had taken a position in the rear of both children.

A spoon is placed in front of each child. Each seizes his spoon. There is more elaborate and abundant manipulation of the spoon by *Baby Seven*. Both follow spoons with interest when the examiner withdraws them. Both reach with mild persistence when spoon is brought back within their scope. The reaching of *Baby Six* appears to be more bilateral in character. The manipulation of the spoon by *Baby Six* is slower and associated somewhat less with visual inspection. *Baby Seven* brandishes the spoon in the air and raps it on the table from time to time, while *Baby Six* mouths it for most of the time. There is definitely more tendency on the part of *Baby Seven* to manipulate and reach with one hand only. There is more perceptual exploitation of the spoon on the part of *Baby Seven*.

When a cube is placed on the table just beyond reach, each child shows persistent effort to attain his cube. Again *Baby Seven* inspects to a greater degree than *Baby Six*. There is a more immediate hand to mouth reaction on the part of *Baby Six*. *Baby Six* picks up cube when it is dropped. *Baby Seven* also picks it up when it is taken out of hand

and dropped. There is apparently more rotation of the hand on the part of *Baby Seven* at the wrist joint. Both children show follow-up interest when the cubes are taken and *Baby Seven* is about to cry because he covets his cube. His disappointment, however, is promptly terminated by pleasurable listening to a bell. He is given the cube and vocalizes with content as soon as he attains it. This is undoubtedly a kind of drive — a marked, exploitive play-eagerness. *Baby Six* shows it, but not to the same extent. Is *Baby Seven* more eager because of more advanced nervous organization? Or is the difference purely temperamental?

A pellet is placed on the table, one in front of each child. *Baby Six* regards the pellet and tries to attain it and makes three efforts to scoop it up. The reaction is a total hand reaction and there is no selective prehension by the fingers. *Baby Seven* makes an equally prompt response and it must also be described as a total manual reaction and not a digital one. By a scratching or raking movement he is able to attain the pellet. Watching this movement carefully from overhead, it is very evident to the examiner that in both hands there is a slight precedence of motion in the thumb and index finger.

*Baby Six* sits momentarily without support when placed in a favorable position. So does *Baby Seven*. *Baby Seven* maintains the sitting posture much longer and is much more erect in this posture. He even plays with his feet while sitting unsupported and pushes off his shoe by a rubbing motion which is evidently very automatic and definitely conditioned.

*Baby Seven* grasps a piece of paper when it is offered edgewise and promptly begins to manipulate it. *Baby Six* grasps it also when it is offered edgewise, but immediately crumples it vigorously and puts it to his mouth. Again

there is a more elaborate exploitive play character to the reaction of *Baby Seven.* *Baby Seven* shifts it from hand to hand, waves it in the air, drops it, picks it up, pats it, and only very occasionally puts it in the mouth.

While they are playing with the paper a bell is rung midway between the two infants. With equal promptness they turn their heads toward the ringing of the bell. The attention span of *Baby Seven* repeatedly shows itself to be somewhat longer, if we judge it by the persistence with which he continues to play with the paper. *Baby Six* is more readily diverted by the play activities of *Baby Seven* and protests less at loss of the paper.

### 8. SEVEN MONTHS, EIGHT MONTHS, AND NINE MONTHS LEVELS

On coming into the room the babies first give regard to the persons in their new environment, and the interest in persons seems to be uppermost, but after a minute *Baby Seven* and *Baby Eight* both give attention to the table and react to it with banging onslaughts. *Baby Eight* at present is the most reactive of the three, and divides his attention between the table and the persons. *Baby Nine* is apparently more interested in what the other babies are doing. The postural control shows a definite gradation from *Baby Seven* to *Baby Nine.* *Baby Seven* needs relatively the most support while in the lap. *Baby Nine* gives most marked impression of motor maturity. *Baby Eight* makes very vigorous banging attacks on the table. The reactions of *Baby Seven* are less vigorous, more tentative, and more awkward. The reactions of *Baby Eight* are bilateral. *Baby Eight* and *Baby Nine* have just made advances to each other, but again *Baby Nine* gives longer attention to his companion. *Baby Eight's* attention readily goes back to the table. *Baby Nine*

is beginning to play with the table. His motion instead of being an up and down banging motion is a side to side brushing motion which occasionally gives way to banging. The control is superior to that of *Baby Eight.*

The babies are placed in a prone position in a row upon the large observation table. In this position there is virtually a staircase progression from *Baby Seven* to *Baby Nine. Baby Seven* sprawls flat and has the chin about four inches from the table. The shoulders and chin of *Baby Eight* are perceptibly higher, being about six inches from the table surface. The altitude of the chin of *Baby Nine* is about eight inches. All the children make locomotive and squirming motions, but only the reactions of *Baby Nine* can be described as true crawling. *Baby Nine* is on his knees and approximates a quadrupedal posture. He also makes definite progress. *Baby Seven* is most uncomfortable in the prone position and protests until taken up in his mother's lap. The motions of *Baby Eight* are regressive rather than progressive. The vigor and development of shoulder muscles is conspicuous in *Baby Nine,* although he does not appear to be physically a more vigorous child. The head posture of the children shows a similar differentiation, being most steady in *Baby Nine,* least steady in *Baby Seven.*

The impulse toward standing is obviously most pronounced in *Baby Nine. Baby Seven* and *Baby Eight* are content to sit in the lap. *Baby Nine* is satisfied now only when crawling.

All three children make spontaneous exploitations of their environment. Just now the exploitation of *Baby Seven* consists in a fingering of the mother's hand accompanied by head and mouth reaching. *Baby Eight* plays for a long time with his mother's wrist watch. *Baby Nine* exploits the ribbon on his sweater in many ways. At no time do the

children seem to lapse into complete quiescence. The picture is one of continuous activity and exploitation of environment.

*Baby Nine* protests by crying when his ribbons are tied behind his back. In lieu of playing with the ribbons he begins to scratch the table and even gives attention to a bit of lint on its surface.

A spoon is now placed on the table in front of each child. *Baby Eight* and *Baby Nine* seize their spoons promptly and directly. *Baby Seven* secures his somewhat later and manipulates it in a comparatively slow and awkward manner, and puts it in the mouth. *Baby Eight* bangs it up and down and converts this into a definite casting play, lifting it about three inches in the air and dropping it repeatedly. *Baby Nine* bangs it, brushes it from side to side, and shifts it from hand to hand. It is noteworthy that a moment ago *Baby Nine* was extremely restless in his mother's lap, but now is quite content to remain seated because he has a spoon to play with. Only occasionally does the spoon go to the mouth, whereas *Baby Seven* mouths the spoon continually. The concentration of *Baby Eight* in his spoon play is so great that he is not diverted by whistling nor even by the ringing of a bell, although ordinarily he would yield to these distractions. In a period of three minutes he playfully drops the spoon and picks it up again by actual count sixty times.

*Baby Eight* and *Baby Nine* both look for the fallen spoon. *Baby Nine* pursues it longer than *Baby Eight*. *Baby Seven* is conscious of its disappearance but does not look for the spoon. *Baby Nine* keeps up a continuous follow-up interest in the spoon for almost a minute.

A cube is placed on the table in front of each child, but well beyond his reach. *Baby Seven* leans toward it. *Baby*

*Eight* shows persistent straining and reaching. *Baby Nine* crawls for it.

A pellet is placed in front of each child. *Baby Seven* regards his pellet and occasionally makes a scratching reaction, but does not actually attain it. *Baby Eight* repeatedly attains the pellet and shows great persistence in pursuing it. He secures it by a movement which is slightly in advance of a palmar scoop in the sense that the forefinger comes definitely into play, but it simulates a palmar scoop more than it does fine prehension. *Baby Nine* is equally interested and persistent. He also makes a movement in which the whole hand participates. The preëminence of the forefinger and thumb, however, is more marked in *Baby Nine*, particularly when he makes lateral attacks and brings forefinger and thumb together by a plucking motion. He plucks in a manner which approaches precise pincer prehension.

The three children are placed in the dorsal position. *Baby Nine* tries to roll over and crawl. *Baby Eight* exploits his opportunity with a banging, kicking motion; *Baby Seven* brandishes legs in air. Three dangling rings are then presented. The most direct and prompt reaction is by *Baby Nine*. He reaches with a unilateral approach, seizes his ring with one hand, and shifts it from one hand to the other. When the children are allowed to play with the rings, *Baby Seven* at once puts the ring to his mouth. *Baby Eight* occasionally puts it to mouth but also handles it with playful manipulation, keeping accompaniment with a staccato drumming of heels. *Baby Nine* shifts his ring about with such definite deliberation that one might almost think he were a curator examining some museum specimen. The interest, however, must be basically kinesthetic, for he continues to manipulate the ring in a similar manner even while he is engaged in looking at *Baby Eight* who lies beside him.

## 9. NINE MONTHS, TEN MONTHS, AND ELEVEN MONTHS LEVELS

After entering the examining room all the babies survey the new surroundings, giving special attention to the persons. Persons interest them more than the furnishings. *Baby Nine* turns his head protectively toward mother. *Baby Eleven* betrays a sense of strangeness and shows some restraint. *Baby Ten* appears composed. *Baby Ten* begins to play with the table on his own initiative and makes advances toward *Baby Eleven.* He crows with satisfaction. His greater activity is very evidently due to the fact that he is somewhat less inhibited emotionally by the new situation. He presently begins to make advances toward *Baby Nine*, plays with the table occasionally with patting strokes, but is more interested in his new companions. If permitted to follow his own devices he would crawl on the table.

When spoons are laid on the table *Baby Ten* immediately picks up the spoon and waves and bangs it. *Baby Nine* also picks it up and exploits it as a play object. *Baby Eleven* is somewhat slow in picking it up but later does so and begins to brandish it. His motion is deliberate and controlled. He shifts the spoon from one hand to the other and is not as much absorbed in it, still giving more attention to the persons in the room. *Baby Nine* and *Baby Ten* for a period, on the contrary, give almost undivided attention to the spoon. There is a gradation in the character of the play responses with the spoon. The responses of *Baby Nine*, to be comparative, may be described as being the most infantile, those of *Baby Eleven* the most advanced. There is more inspection of the spoon on the part of *Baby Eleven.* The hand to mouth reaction has asserted itself a few times in

both *Baby Nine* and *Baby Ten.* If anything the play reactions of *Baby Ten* approximate those of *Baby Nine* more than those of *Baby Eleven. Baby Nine* enjoys throwing the spoon and following it with his eyes. All children respond definitely to the examiner's request, supplemented with a receptive gesture, in which he says, "Give me the spoon," repeatedly. *Baby Nine* listens, *Baby Ten* moves the spoon toward the hand but increases his hold on the spoon, *Baby Eleven* definitely withdraws it. The clinical impression given in this situation was that *Baby Eleven* came the nearest to understanding the situation, and was most aware of the impending deprivation of the spoon.

*Baby Nine* gives up the spoon most readily when it is withdrawn by the examiner and gives immediate attention to the block which is substituted, picking it up with definite thumb opposition and placing it in the mouth rather promptly. *Baby Ten* resists withdrawal of the spoon, but accepts with avidity the block and begins to play with it in a sportive manner. *Baby Eleven* is emotionally disturbed by the withdrawal of the spoon, but soon accepts the cube as a substitute play object.

The preferred play of *Baby Nine* is a banging of the cube on the table. *Baby Ten* does not bang nearly as much but turns the cube about in various situations, shifts it from one hand to the other, and does less throwing. He puts the cube into the mouth occasionally but not as persistently as does *Baby Nine.* In general manipulation quality there is more exploitation in *Baby Ten* than in *Baby Nine.* The reactions of *Baby Eleven* to the cube are somewhat modified by his interest in the other babies, but when he does play with it his actions are much more restrained and perhaps more discriminating. He explores and moves it about with his little finger. Unquestionably his control is advanced beyond that

of *Baby Ten.* There is also a larger amount of visual inspection as he rotates the cube.

When the cubes are placed out of reach *Baby Nine* makes a vigorous body reaching effort, attains the cube, and reverts to energetic banging. *Baby Ten* also reaches vigorously and protests audibly, but vocalizes delicious satisfaction when he attains the cube. He exploits it very vigorously as a play object and brings the cube into many new relations. Unquestionably the diversity of his reactions to the cube is greater than *Baby Nine's.* Both children accept the second cube when it is offered but neither exploits it very definitely as an additional play object. Each child seems to be content with one cube, disregarding the second when it falls on the table or to the floor. While playing with a single cube a second cube is again proffered just out of reach for each child. A few moments ago this proffer excited definite, vigorous reaching movements, but it no longer excites this reaction, because each child is satisfied with one cube in hand. If, however, *Baby Ten* and *Baby Eleven* were left to play spontaneously they would undoubtedly bring two cubes into relation.

*Baby Nine* stands with support. *Baby Eleven* not only stands with support but is able to push around a peach basket on which he holds. *Baby Ten* crawls vigorously. *Baby Nine* and *Baby Ten* crawl with equal vigor and pull themselves up to standing position by a chair. *Baby Nine* is also able to let himself down onto the floor again, which shows considerable control for this age. The crawling of *Baby Ten* shows better coördination and steadier control than that of *Baby Nine. Baby Eleven* in the crawling position makes the most rapid progress of the trio and also attains a standing position with ease, though he is unassisted.

### 10. ELEVEN MONTHS AND TWELVE MONTHS LEVELS

After the babies enter the examining room they both give chief attention to the persons in the room, showing sensitiveness to the strangeness of the environment, but no definite timidity. All movements of the examiner are closely watched and *Baby Twelve* turns his head far around in order to keep his eyes on the examiner even when the latter retreats to the rear.

A spoon and an enameled saucer are presented to each child. *Baby Eleven* takes the spoon in the left hand, picks up the saucer in the right, and then brings the spoon and saucer into relation with each other, pounding one against the other. When the spoon drops on the table he applies the saucer to the spoon. He then picks up the spoon. There is no doubt that he is giving attention to both objects and is bringing them into productive play relation. *Baby Twelve* also picks up the saucer though he is much distracted by his interest in the active play of *Baby Eleven.* Presently he bangs the saucer with the handle of the spoon. His actions show a quality of deliberateness and restraint greater than that of *Baby Eleven.* His control is evidently more steady and mature. In his play he pushed the saucer out of his reach. He then used the spoon to pull it toward him. In his play *Baby Eleven* seizes saucer from *Baby Twelve* and brings both saucers into relation. This degree of combining play activity has not been observed in the earlier comparative pairs.

A pellet is placed in front of each child. *Baby Eleven* picks up the pellet with direct pincer prehension with partial overhead attack. *Baby Twelve* picks it up in the same manner, but instead of putting it to the mouth as *Baby Eleven* did, he exploits it as a play object, discriminatingly pushing it about on the table surface, using his index finger

for the purpose. He places the index finger with good aim and accuracy on the top of the pellet. He accompanies this play with a prattled soliloquy.

A performance box and, later, a small wooden, cylindrical rod (1 cm. x 10 cm.) are presented to each child. [One side of the box (25 cm. x 38 cm.) has a small, round hole (diameter 2 cm.) in the middle, and a small, rectangular hole (2 cm. x 3.2 cm.) and a large, rectangular hole (2.5 cm. x 7.6 cm.) on either side of the round hole. This surface is presented perpendicularly, confronting the child.] When the performance box is presented without the rod, *Baby Eleven* makes active manual explorations of the three openings in the box. These engage his interest for some time. He uses the rod to pound with and makes awkward efforts to approach the holes, and sometimes thrusts it in on first intention. When the performance box is presented to *Baby Twelve*, his reaction is immediately selective and adaptive. He at once thrusts his left hand in the rectangular opening and his index finger in the small circular opening, giving immediate attention to these openings and vocalizing with pleasure as he manipulates the edges. When he is presented with the rod he at once uses the rod adaptively and thrusts it into the circular hole.

A small form-board (16 cm. x 36 cm.) is presented, with a circular, a square, and a triangular hole and blocks to fit. *Baby Twelve* makes a more discriminating adjustment to the form-board situation. He holds up the board in the left hand vertically, and then thrusts the round block through the circular opening as he holds it in the air. This is possibly a carry-over from the performance box. After that he plays in a nonadaptive manner, pushing the block around with his little finger. In the midst of his exploitation he places the block on his head in an amusing manner, which excites

the laughter of the audience, to which he is quite sensitive, and he immediately repeats the performance in order to get the same laughter. Even after the block is taken from him he puts his hand quickly up to his head in order to bring about the same social result. This clearly indicates the characteristic previously noted, namely his sensitiveness to the social environment. It also indicates how readily behavior is conditioned by social practice.

## II. GENERAL COMMENT

The foregoing comparative survey, perhaps because of its very sketchiness, has served to emphasize the developmental luxuriance of infancy. The survey began with a month old babe still near the margin of vegetative existence. The survey ended with a vivid 12 month babe who dramatically placed a form-board block on his head to win our plaudits, — and to demonstrate the amazing psychological advance which his whole personality had achieved in the short space of a year.

The swiftness of development in infancy no one will be disposed to deny. The orderliness of this development is not so well recognized, but it is a fact of great significance. There are certain basic uniformities in the dynamics of development which apply to all infants, normal, abnormal, superior, inferior. There is a large system of uniformities which characterize all normal infants and keep them traveling on highly similar routes and on highly similar time tables. These uniformities are not stereotyped; they shade into small but important variations. Differential psychology must define and interpret these variations. Genetic psychology will emphasize the underlying similarities.

If chance played any considerable part in the determination of development, one hundred ordinary infants of the

same age, say six months, would display a vast array of permutations and combinations in their behavior pictures. One infant would be reaching for an object, another would not even be looking at an object, another would be solving form-boards, another would be just beginning to inspect his hand. No such kind or degree of variation occurs. In our experience we have not even seen one child adapt to the square hole in the form-board before the circular. Nor does the child draw a square before he draws a circle. It is a law of nature, a law of mental growth, that one performance should precede the other at a certain stage of maturity.

Individual differences in rate and style of growth are manifested even in infancy; but they do not displace a basic community of characters, which mark the species, the race, or the group. Development is so ballasted by organic tendencies that it conforms to certain orders of succession, or to paradigms. These modes of developmental procedure have become slowly established through the ages. They are not absolutely fixed, but they are profoundly stable. They constitute the mechanics or the laws of growth. They are the economy of development. They make infants of an age alike; they prevent miracles from happening. They project the order of nature even into the bewildering multifariousness of child development.

"Norms of development" may be regarded as an effort to catch or characterize certain fundamental identities which underlie human growth. Theoretically such norms are all but infinite in number. Fortunately the coherence of development is so great that one true norm becomes fairly representative of a host of other potential norms. The task of normative psychology is, therefore, a search for those norms which for statistical and biological reasons have optimum representative value.

# CHAPTER VI

# AN INFANT DEVELOPMENT RECORDING SCHEDULE

## A Graded Schedule for the Normative Study of Infant Behavior

The growth continuum consists of a countless series of moments. It can never be studied in all its completeness. Considered statically, the field of behavior is like a map upon which we may draw any number of lines of latitude and longitude. Convenience and necessity will determine the actual number drawn. In our first survey of the pre-school field of behavior we chose to select nine different levels for normative study. Six of these levels were located in the first two years of life. Fifty normal infants were investigated at each level.

Although these gradations are sufficient to meet ordinary clinical situations, it soon became apparent that we should need a somewhat finer calibration in order to plot more precisely the trends and deviations of development in infancy. Using our earlier normative data as points of departure, we undertook (in 1924)[1] to draw up a syllabus of behavior items which would cover the same territory in greater detail and with a narrower zoning. A schedule of some fifty items was framed — four for each of the monthly intervals in the first year. This schedule was later expanded in a provisional

[1] Gesell, Arnold, "Monthly Increments of Development in Infancy." *The Pedagogical Seminary and Journal of Genetic Psychology,* 1925, Vol. 32, pp. 203–208.

form to extend to the thirtieth month and graded on the basis of sixteen intervals, as follows: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 15, 18, 21, 24, and 30 months. The aggregate number of specific behavior items in the expanded schedule is 195.

There are approximately a dozen items at each age level, covering motor, language, adaptive, and personal-social aspects of behavior.

The procedure in the test situations follows that outlined for the system of developmental diagnosis reported in an earlier volume. The schedule is in a formative stage of development. It is being recast on the basis of lunar months rather than solar months in the first year of life. It is planned ultimately to publish specific procedures and diagnostic norms in a detailed manual. That the reader of the present volume may have general familiarity with the content of the schedule, we shall briefly summarize the behavior items assigned to each one of the series of sixteen developmental levels.

In its present preliminary form the developmental schedule has proved useful in clinically following the mental growth of infants from one month to three years of age. Being a graded schedule, with approximate normative values, it has enabled the examiner to compare the same infant at several successive age levels, and to compare normal and subnormal infants analytically with reference to a relatively large number of items. The schedule has been used only by trained examiners, and always in association with supplementary data which were weighted in deriving the developmental estimates. The examinations have been made under clinical auspices as part of the individual growth studies which are reported in later chapters.

The items of the recording schedule are reproduced below as normative summaries for each of the developmental levels.

These items have been given an age location; it is clear, however, that they cannot be scored on a purely plus and minus basis and arithmetically compounded into a psychometric mental age. It must be emphasized that serious use of the schedule, in its present form, presumes a large amount of clinical familiarity with infants of every age.

### 1. NORMATIVE SUMMARY FOR ONE MONTH LEVEL

*Motor Development.* (*a*) Lifts head from time to time when held to the shoulder; (*b*) Makes crawling movements when laid prone on flat surface; (*c*) Lifts head intermittently, though unsteadily, when in this prone position; (*d*) Turns head laterally when in prone position.

*Language.* (*a*) Gives definite heed to sound; (*b*) Has differential cries for discomfort, pain, and hunger.

*Adaptive Behavior.* (*a*) Stares at a window or at massive objects; (*b*) Gives visual heed to conspicuous moving objects; (*c*) Gives transient visual regard to the red ring;[1] (*d*) Retains definite hold of the ring when it is placed in the hand.

*Personal-Social Behavior.* (*a*) Makes tactually perceptible postural adjustments when taken up by the examiner; (*b*) Shows selective regard for the face.

### 2. NORMATIVE SUMMARY FOR TWO MONTHS LEVEL

*Motor Development.* (*a*) Holds head erect for a short time when held to the shoulder; (*b*) Lifts head when suspended dorsally (the head being momentarily unsupported to test the compensatory postural adjustment); (*c*) Lifts the chest a short distance above the table surface when in the

[1] Item 7, p. 45 in Chapter VI on "Psychological Materials and Apparatus," *The Mental Growth of the Pre-School Child.* All other test materials referred to in this chapter are described in the same volume in Chapter VI.

prone position; (*d*) Makes vertical arm thrusts in random play when in the dorsal position.

*Language.* (*a*) Attends readily the speaking voice; (*b*) Makes a facial response to a social approach (in which the examiner brings face near the child to attract attention); (*c*) Makes several different vocalizations.

*Adaptive Behavior.* (*a*) Eyes follow moving person; (*b*) Gives prolonged regard to dangling red ring.

*Personal-Social Behavior.* (*a*) Head turns or fixates in response to speaking voice; (*b*) Makes definite motor adjustment, in shoulder region, to being lifted; (*c*) Kicks feet in bath or reacts with pushing leg movements.

### 3. NORMATIVE SUMMARY FOR THREE MONTHS LEVEL

*Motor Development.* (*a*) Holds head erect and steady when held to shoulder; (*b*) Rotates body from dorsal to side position; (*c*) Pushes or elevates self by arms in prone positon.

*Language.* (*a*) Smiles responsively to social approach; (*b*) Gives vocal expression to feelings of pleasure.

*Adaptive Behavior.* (*a*) Eyes follow moving pencil; (*b*) Head turns freely in inspection; (*c*) Varied tactile manipulation of ring; (*d*) Varied inspection of environment (when in dorsal position).

*Personal-Social Behavior.* (*a*) Startles or betrays awareness when suddenly changed to a strange situation; (*b*) Quieted by voice or music; (*c*) Shows anticipatory excitement, or opens mouth expectantly in feeding; (*d*) Fingers one hand with the other in tactile motor play.

### 4. NORMATIVE SUMMARY FOR FOUR MONTHS LEVEL

*Motor Development.* (*a*) Holds head steady when carried or when swayed; (*b*) Lifts head and shoulders in dorsal position as an effort toward sitting; (*c*) Sits with resistant

body posture when supported by pillows; (*d*) Hands no longer predominantly clenched, but frequently open.

*Language.* (*a*) Laughs aloud; (*b*) Responds vocally when socially stimulated; (*c*) Vocalizes in self-initiated sound play.

*Adaptive Behavior.* (*a*) Closes in with both hands on dangling ring, when in dorsal position; (*b*) Manipulates table edge when held in lap; (*c*) Regards one inch cube on table; (*d*) Turns head in pursuing slowly vanishing object.

*Personal-Social Behavior.* (*a*) Inspects own hand in play; (*b*) Plays in simple manner with rattle; (*c*) Splashes with hand in bath; (*d*) Makes definite anticipatory adjustment to being lifted.

### 5. NORMATIVE SUMMARY FOR FIVE MONTHS LEVEL

*Motor Development.* (*a*) Rolls from back to stomach; (*b*) Sits with slight prop; (*c*) Picks up cube from table on contact.

*Language.* (*a*) Turns head to voice or to hand bell; (*b*) Gives vocal expression of eagerness; (*c*) Vocalizes displeasure on withdrawal of coveted object.

*Adaptive Behavior.* (*a*) In dorsal position recovers rattle which has fallen within easy reach; (*b*) Makes reaching approach to piece of paper favorably presented; (*c*) Eyes coöperate in prehension and manipulation.

*Personal-Social Behavior.* (*a*) Plays actively with rattle with recurring visual regard; (*b*) Exploits bath playfully.

### 6. NORMATIVE SUMMARY FOR SIX MONTHS LEVEL

*Motor Development.* (*a*) Sits momentarily without support, if placed in a favorable leaning position; (*b*) Grasps with simultaneous flexion of fingers; (*c*) Retains transient hold of two cubes, one in either hand.

*Language.* (*a*) Vocalizes several well-defined syllables; (*b*) Expresses recognition of familiars; (*c*) Actively vocalizes pleasure with crowing or cooing.

*Adaptive Behavior.* (*a*) Reaches for object on sight; (*b*) Picks up cube from table on visual cue; (*c*) Regards pellet placed on table surface.

*Personal-Social Behavior.* (*a*) Bangs spoon or pats table in play; (*b*) Discriminates between strangers and familiars.

### 7. NORMATIVE SUMMARY FOR SEVEN MONTHS LEVEL

*Motor Development.* (*a*) Tends to unilateral reaching and manipulation; (*b*) Rotates wrist freely in manipulation; (*c*) Secures pellet with raking or scooping palmar prehension; (*d*) Picks cube deftly and directly from table.

*Language.* (*a*) Vocalizes satisfaction in attaining object.

*Adaptive Behavior.* (*a*) Reaches persistently for remote cube; (*b*) Lifts inverted cup; (*c*) Manipulates ring with sustained inspection; (*d*) Gives transient heed to fallen spoon.

*Personal-Social Behavior.* (*a*) Plays exploitively with paper; (*b*) Plays exploitively with string; (*c*) Reacts to mirror image by manipulation or approach.

### 8. NORMATIVE SUMMARY FOR EIGHT MONTHS LEVEL

*Motor Development.* (*a*) Sits momentarily without support. (*b*) Raises self to sitting position; (*c*) Picks up pellet with partial finger prehension.

*Language.* (*a*) Gives vocal expression to recognition; (*b*) Vocalizes in interjectional manner.

*Adaptive Behavior.* (*a*) Definitely looks for fallen spoon; (*b*) Utilizes handle in lifting inverted cup; (*c*) Shows manipulatory interest in details of bell.

*Personal-Social Behavior.* (*a*) Shows definite responsiveness to frolic play; (*b*) Pats or smiles at mirror image; (*c*) Restores bottle to mouth; (*d*) Shows interest in throwing and sound production play.

### 9. NORMATIVE SUMMARY FOR NINE MONTHS LEVEL

*Motor Development.* (*a*) Sits alone; (*b*) Opposes thumb in seizing cube; (*c*) Makes a locomotive reaction in prone position.

*Language.* (*a*) Says Da-da or equivalent; (*b*) Listens with selective interest to familiar words.

*Adaptive Behavior.* (*a*) Brings inset block and form-board into exploiting relation; (*b*) Uses string and pulls ring; (*c*) Gives definite attention to scribbling demonstration.

*Personal-Social Behavior.* (*a*) Coöperates in rhythmic nursery games; (*b*) Waves bye-bye or performs similar trick; (*c*) Plays combiningly with cup and cube.

### 10. NORMATIVE SUMMARY FOR TEN MONTHS LEVEL

*Motor Development.* (*a*) Pulls self up to standing position; (*b*) Plucks pellet with precise pincer prehension.

*Language.* (*a*) Incipient or rudimentary imitation of sounds; (*b*) Makes conditioned adjustment to certain words.

*Adaptive Behavior.* (*a*) Accepts third cube or retains two cubes; (*b*) Makes incipient, induced imitation of scribble; (*c*) Explores form-board holes manually; (*d*) Lifts cup by handle and secures concealed cube.

*Personal-Social Behavior.* (*a*) Makes playful response to mirror image; (*b*) Dangles ring by string in play.

### 11. NORMATIVE SUMMARY FOR TWELVE MONTHS LEVEL

*Motor Development.* (*a*) Walks with help; (*b*) Lowers self from standing to sitting position; (*c*) Holds crayon adaptively to make stroke.

*Language.* (*a*) Says two "words"; (*b*) Adjusts to simple verbal commissions; (*c*) Places cube in or over cup on command.

*Adaptive Behavior.* (*a*) Imitates scribble or rotary spoon rattle; (*b*) Adjusts round block to form-board or rod to hole; (*c*) Uses string adaptively to pull ring; (*d*) Secures cube wrapped in paper.

*Personal-Social Behavior.* (*a*) Holds cup to drink from; (*b*) Inhibits simple acts on command; (*c*) Repeats performance laughed at.

### 12. NORMATIVE SUMMARY FOR FIFTEEN MONTHS LEVEL

*Motor Development.* (*a*) Stands alone; (*b*) Walks alone.

*Language.* (*a*) Says four words; (*b*) Uses expressive jargon.

*Adaptive Behavior.* (*a*) Secures third cube; (*b*) Builds tower of two blocks; (*c*) Makes discriminative reversed adaption of round block to form-board.

*Personal-Social Behavior.* (*a*) Uses spoon; (*b*) Coöperates in dressing; (*c*) Bowel and bladder control regularized.

### 13. NORMATIVE SUMMARY FOR EIGHTEEN MONTHS LEVEL

*Motor Development.* (*a*) Climbs stairs or chair; (*b*) Throws ball into box; (*c*) Scribbles spontaneously and vigorously.

*Language.* (*a*) Says five or more words; (*b*) Uses jargon conversationally; (*c*) Points to nose, eyes, or hair.

*Adaptive Behavior.* (*a*) Builds tower of three or more blocks; (*b*) Makes an imitative stroke with crayon; (*c*) Places cube in cup or plate; (*d*) Accepts four or more cubes.

*Personal-Social Behavior.* (*a*) Uses spoon with good control; (*b*) Fills cup with cubes in play; (*c*) Turns pages of book; (*d*) Looks at pictures.

### 14. NORMATIVE SUMMARY FOR TWENTY-ONE MONTHS LEVEL

*Motor Development.* (*a*) Walks attended on the street; (*b*) Walks backward; (*c*) Differentiates between stroking and circular scribble.

*Language.* (*a*) Joins two words in speech; (*b*) Names one picture; (*c*) Repeats things said.

*Adaptive Behavior.* (*a*) Places square in form-board; (*b*) Differentiates between tower and bridge; (*c*) Folds paper once on demonstration.

*Personal-Social Behavior.* (*a*) Bowel control established; (*b*) Asks for things at table (or for toilet); (*c*) Pulls persons in order to show something of interest; (*d*) Tries to turn door knob.

### 15. NORMATIVE SUMMARY FOR TWENTY-FOUR MONTHS LEVEL

*Motor Development.* (*a*) Runs; (*b*) Piles tower of six blocks with good coördination; (*c*) Imitates vertical or horizontal strokes.

*Language.* (*a*) Names three of five objects; (*b*) Points to five objects on card; (*c*) Uses words in combination.

*Adaptive Behavior.* (*a*) Places blocks in row to make train; (*b*) Adapts to reversal of form-board; (*c*) Creases paper definitely in imitation; (*d*) Places cube in cup, plate, or box.

*Personal-Social Behavior.* (*a*) Plays with mimicry; (*b*) Tells experiences; (*c*) Listens to words or phrases; (*d*) Explains pictures.

### 16. NORMATIVE SUMMARY FOR THIRTY MONTHS LEVEL

*Motor Development.* (*a*) Goes up and downstairs alone; (*b*) Piles seven or eight blocks with coördination; (*c*) Tries to stand on one foot; (*d*) Copies vertical or horizontal line.

*Language.* (*a*) Points to seven pictures; (*b*) Names five pictures.

*Adaptive Behavior.* (*a*) Attempts to build bridge from model; (*b*) Adapts to form-board with corrected initial error; (*c*) Places one completion form; (*d*) Marks twice for cross.

*Personal-Social Behavior.* (*a*) Gives full name; (*b*) Helps mother to put away things.

# PART TWO

# GENETIC STUDIES OF INFANT BEHAVIOR

# CHAPTER VII

# THE TEMPO AND TREND OF INFANT DEVELOPMENT

## A Summary of Mental Growth Studies of One Hundred Infants

This and following chapters make summary report of the results of developmental studies of over one hundred infants who were examined at repeated intervals to determine facts relating to the tempo and trend of development in each individual. All told more than five hundred individual developmental examinations were made. Ninety of these studies of mental growth, aggregating 429 examinations, will be discussed as a group. Additional cases representing a wide range of variation will be considered individually in succeeding chapters.

### 1. QUANTITATIVE FORMULATIONS OF DEVELOPMENT

The quantitative study of early development is beset with great difficulties. There is no sensitive meter which we can apply to the complex current of developmental progress and secure a simplified indication of its strength, direction, or rate of flow. And yet, as indicated in the foregoing section, it is possible to secure approximate readings of the behavior picture at advancing age levels. By an approximate reading we mean a normative characterization of developmental maturity as it expresses itself in behavior values. By a behavior value is meant an order or item of

behavior, which can be objectively rated and assigned to a characteristic age level. In the strictest mathematical sense, development cannot be quantitatively expressed unless science comes into possession of true absolute units of measurement. Lacking these it is still possible to make successive inventories which yield graded series of values. Such determination should furnish a preparatory basis on which to rest a study of the consistency and variability of development.

The quantitative formulations which are to follow are intended simply to express the preliminary results of an exploratory investigation. The statistical statements made can hardly be advanced to validate our methods of clinical study. These methods must be judged on their merits. A clinical estimate of developmental status, as the term is here used, is not a subjective impression. It is a judgment controlled by objective evidence; though it cannot claim the stability and verifiability of rigorous mensuration. A judgment becomes normative when it is made comparative and is defined in terms of working norms or preëstablished criteria. When the norms are accurate, and the comparison precise, such a judgment has certain essentials of a true measurement. It is in this sense that we would hold that clinical or normative determinations in the hands of adequately trained persons give an approximation to a genuine measure, and may serve for blocking out a more refined methodology.

## 2. SCOPE AND PROCEDURE OF THE GROWTH STUDIES

The general procedure and approach in the present series of studies are set forth in an earlier volume, which described in detail a system of developmental diagnosis applicable to children of pre-school age. This volume also described

materials and norms used in addition to the *Infant Development Recording Schedule* outlined in the foregoing chapter. By means of the latter schedule it was possible to make developmental examinations of children at intervals of one, two, or three months as the case required. It has been part of our objective to ascertain by these more frequent determinations of developmental level the consistency of the course of mental growth in the first two years of life.

The growth studies represent a wide range of infants, normal and otherwise, who were repeatedly examined in connection with clinical or research work. The studies are assembled in the present chapter to determine whether in spite of their diversity they warrant conclusions of a general nature concerning the tempo and trend of early development. As indicated, there were ninety children and 429 individual examinations. Each child was seen on the average more than four times. One third of the children were seen from six to ten times. The examinations were made chiefly by the writer and by Miss Ruth Washburn and Miss Elizabeth Lord.

The ninety subjects group themselves roughly into four equal divisions with reference to their developmental status: (1) Average; (2) High average and superior; (3) Low average and inferior; (4) Subnormal. This distribution of subjects will enable us to bring the four subdivisions into comparison.

A large proportion of children who were examined at the Yale Psycho-Clinic had been referred for diagnosis and advice. This applies particularly to the subnormal group. Other infants, classified as normal and superior, were brought to the clinic on the mothers' own initiative. These mothers were interested in having a repeated survey made and in securing suggestions and guidance in connection with the

examinations. One small group of mothers was organized into a parent-guidance group at a suburban child-welfare conference. The contact with this group of mothers was regular and systematic. Still other infants were repeatedly examined in connection with the supervisory service which the clinic manages at the Babies' Building of a large local agency working with dependent or otherwise needy children. In all instances, therefore, the developmental examination had a medical or service aspect in addition to a scientific one.

The investigation deals chiefly with the first two years of mental growth. Fifty per cent of the infants were examined before they were nine months old. Eighty per cent were examined before they were eighteen months of age. And the small number of cases which were over forty-eight months old at the time of the first examination were the seriously retarded cases rated at a level of less than two years.

The accompanying tables summarize the number of examinations, the age at the time of the first examination, and the age at the time of the last examination.

NUMBER OF EXAMINATIONS

| TIMES EXAMINED | NO OF CASES | NO. OF EXAMINATIONS |
|---|---|---|
| 2 . . . . . . . . . . | 13 | 26 |
| 3 . . . . . . . . . . | 14 | 42 |
| 4 . . . . . . . . . . | 22 | 88 |
| 5 . . . . . . . . | 12 | 60 |
| 6 . . . . . . . . . . | 10 | 60 |
| 7 . . . . . . . . . . | 5 | 35 |
| 8 . . . . . . . . . . | 10 | 80 |
| 9 . . . . . . . . . . | 2 | 18 |
| 10 . . . . . . . . . . | 2 | 20 |
| Total . . . . . . . | 90 | 429 |

Age at the Time of the First Examination

| Age | No. of Cases | Per Cent |
|---|---|---|
| Under 3 months . . . . . . | 10 | 11 |
| Under 6 months . . . . . . | 30 | 33 |
| Under 9 months . . . . . . | 45 | 50 |
| Under 12 months. . . . . | 61 | 68 |
| Under 15 months. . . . . | 68 | 75 |
| Under 18 months. . . . . | 72 | 80 |

Age at the Time of the Last Examination

| Age | No. of Cases | Per Cent |
|---|---|---|
| Over 7 months . . . . . . | 90 | 100 |
| Over 12 months . . . . . . | 84 | 93 |
| Over 18 months . . . . . . | 70 | 78 |
| Over 24 months . . . . . . | 47 | 52 |
| Over 30 months . . . . . . | 37 | 41 |
| Over 36 months . . . . . . | 32 | 36 |
| Over 42 months . . . . . . | 27 | 30 |
| Over 48 months . . . . . . | 24 | 27 |

### 3. DEVELOPMENTAL DATA

The summary developmental record after each examination carried the following entries: (1) The number of examinations; (2) Date of the examination; (3) Age; (4) General developmental level; (5) Rating for motor development; (6) Rating for language development; (7) Rating for adaptive-behavior; (8) Rating for personal-social behavior.

In some instances the data did not make possible separate ratings for all of the four special fields of behavior (motor, language, adaptive, and social). In every instance, however, a careful survey of all the data was made in order to derive the summarizing estimate of a general developmental level. This estimate was expressed in terms of months, and

when necessary the numerical designation was shaded with a plus or minus sign. The individual developmental tests were not scored in an arbitrary manner, nor were they arithmetically compounded. Every effort was used to make the final estimate of developmental level as critical and judicious as possible. Supplementary descriptive and interpretative statements were made with reference to the behavior picture, the personality characteristics, and developmental outlook. Each succeeding examination was made on its own independent merits, but it would have been impossible to keep the examiner in scientific ignorance of the previous ratings.

As a matter of fact, the repeated examinations were made by the same examiners, and it was our purpose to build up a cumulative familiarity with the child. In each instance, therefore, the last examination was brought into comparison with the results of the preceding examination. A new series of ratings was made and the data on the previous examination were used critically in the weighting of the succeeding examination. The antecedent ratings were not changed. They were simply reviewed. In summary terms, the problem each time was to decide whether, in the light of the data, the antecedent estimate could be confirmed, or whether it needed to be reduced or advanced in the new rating.

When the data were assembled for statistical treatment, each case was again reviewed in its entirety, and a "final" developmental index was assigned to it. This final developmental index was expressed by the per cent of deviation of the final general developmental level from the chronological age. This final assigned index, therefore, represents a rating which can be used as a basis for calculating the consistency of a series of developmental examinations. If the individual serial developmental estimates and the final index corre-

spond, there is of course no deviation to be recorded. This would represent perfect consistency of development.

It is profitable to inquire to what extent our data approximate such perfection of consistency or constancy of development. In order to make this inquiry it was necessary to make simple calculations of the deviations of each individual serial developmental rating from the chronological age, and also from the final developmental index.

The form used for the analytic treatment of the data carried thirteen columns indicated alphabetically as follows:

Column A. Number of the examination.

Column B. Chronological age in months.

Column C. Deviation in months of the general developmental age from the adjacent chronological age. In parentheses, this same deviation expressed in percentage.

Column D. Deviation of motor age-level from chronological age. In parentheses, the per cent deviation of motor from chronological age.

Column E. Deviation of language age-level from chronological age. In parentheses, the per cent deviation of language from chronological age.

Column F. Deviation of adaptive-behavior age-level from chronological age. In parentheses, the per cent deviation of adaptive behavior from chronological age.

Column G. Deviation of personal-social age-level from chronological age. In parentheses, the per cent deviation of personal-social age from chronological age.

Column H. The asterisk (*) in column H located the time when the first consistent clinical classification was made.

Column I. The difference between the final index and the serial developmental age index.

Columns J, K, L, M. The difference between the final index and the serial index for motor, language, adaptive behavior, and personal-social age-level.

The term *adaptive behavior* approximates the term intelligence, but cannot be made strictly, equivalent. Moreover,

the data in the present chapter are not concerned with intelligence as such, but with developmental maturity levels. It is our general problem to inquire into the consistency of a series of maturity ratings in relation to chronological age.

### 4. THE CONCEPT OF MATURITY LEVEL

Before proceeding with a discussion of the data which deal with the consistency of the serial developmental estimates, it is necessary to recognize the limitations of the term "level." Spearman has sharply criticized what he calls "the pseudo-explanation of the tests of a person's 'intelligence' as measuring a 'level,' 'average,' or 'sample' of his abilities, whereas really no such measurement is conceivably possible — or, in truth, has ever genuinely been attempted."[1]

If we interpret correctly, this criticism is aimed particularly at the measurement of intelligence as a complex of abilities. Is it not possible that the concept of "level" retains a certain usefulness, in the field of developmental psychology, even though it may be mathematically indefensible for the scientific measurement of human abilities? The term "level" signifies a stage or degree of progression in an *ordered* cycle. As such, the term would seem to have at least provisional value in the twilight zone between "mere" description and absolute mensuration. An illustration is ventured in the next paragraph.

A baby for the first time in his life looks at his hand. He is three months old. It is a transient, fugitive regard. The oculomotor muscles fixate for a moment, the hands come to rest at a synchronous moment. Now this is not a pure unit of behavior, nor, perhaps, an ability; but it *is* a behavior

[1] Spearman, C., *The Abilities of Man: Their Nature and Measurement.* New York, The Macmillan Company, 1927. P. 410.

*event*, a behavior *value*. It is a value because it was observed in relation to an age, and because it denotes at that determined age a degree or stage of neuromuscular maturity. The age and the growth cycles pursue their course. The baby reaches the age of four months. We observe him again, and find that his eye-hand fixation is much prolonged. He literally gazes or seems to gaze at his hands for 5, 10, 20, 30 seconds. This too is a behavior value; a new behavior value. It denotes a more advanced degree of maturity. It is an indicator. The precise amount of indicativeness can only be expressed after a vast amount of detailed investigation; but a quantification of the behavior event in terms of agedness or level is permissible, pending a more intrinsic mathematical expression of the performance. When this perfect expression becomes available, it will still be advantageous to bring it into relation to age. Meanwhile a comparative judgment which discriminates between the three months level of eye-hand behavior and four months level of eye-hand behavior is a rough measurement — one of a potential host of perfectible measurements which will help to disclose individual differences in developmental tempo and trend.

In our repeated examinations of infants we have assumed in the above sense that degrees or levels of increasing maturity exist in specific items of behavior, like hand inspection; in fields of behavior, like locomotion; also in the general behavior picture of the total individual. This picture surely changes with each month of infancy. The direction of change and, roughly, the degree of change, are expressed in an advancing series of age values. The possibilities and sources of error in making the actual estimates may be granted without invalidating the principles of the method or the concept of developmental level. The greatest oppor-

tunity for refining the accuracy of the results probably lies in the statistical improvement of the age norms of behavior and in the perfection of discriminative methods of scoring. It is a fact of technological significance that the refinement of age norms depends not only upon greater subtlety of technique, but upon reducing the selective size of the age intervals. This is notably true in the study of early infancy.

### 5. THE COHERENCE OF GROWTH AND AGE

Accordingly in the present investigation the following postulates are implied and tested. Mental growth (or development) is conceived as a process or complex ordered and conditioned by the factor of age. This process as an organic whole (or in organic subdivisions) has a characteristic rate of progression (tempo). It has a general trend indicated by its past and potential products. It has personal pattern determined by the configuration and dynamic interplay of its components. In the latter direction, particularly in adults, the concepts of mental growth and of mental ability tend to overlap. From the bionomic or biographic point of view, however, mental growth always remains the more inclusive concept. The most potent, significant and comprehensive of all abilities is the "ability" to grow.

For summary exposition we have cast our available data concerning the development of infant behavior into one pool. Subnormal, normal, average, and superior are brought together by the common denominator of the developmental age rating. This procedure focuses on the central question, Is development obedient to age?

The data have been tabulated with special reference to the coherence or discrepancy between the several serial developmental age ratings and the final developmental index assigned to each individual case. This final index represents

the final, seasoned estimate of the child's potential status, on the combined evidence of all the individual examinations, and the supplementary clinical evidence accrued through recurring contact with the child. The rating is based on a scale of developmental quotients with zero as the median value, and is expressed in plus or minus per cent of deviation from this median. Since this final clinical rating is formulated in per cent deviation, it is simple to compute the discrepancy between it and any of the serial developmental ratings (general, or specific for motor, language, adaptive, or personal-social behavior). The average amount of these discrepancies, expressed in percentile points of deviation, will indicate the constancy or steadiness of the developmental course. The range of the discrepancies will indicate this still more rigorously by defining the extremes of fluctuation. The accompanying tables summarize the average, absolute deviations of the serial developmental estimates and the range of these estimates.

Both tables show a high degree of constancy or consistency. In fifty per cent of the ninety cases the average absolute divergence was less than five points. In eighty-four per cent of the cases it was less than ten points. These averages do not take account of plus and minus signs, and express the tendency of the curve of development to cleave to a central course. From a clinical standpoint, however, we ought to recognize the whole span or range of divergence and not disregard the plus and minus signs. This makes the divergence appear somewhat larger; but still denotes a high degree of constancy in the developmental tempo. In sixty-two per cent of ninety cases there was a total range of divergence of less than fifteen points.

It should be repeated that these figures are a statistical expression. They show the drift or general import of the

data as a whole. The figures might easily have been improved if we had left out of the reckoning certain special instances in which the clinical complications readily accounted for the divergent ratings. Construed as individual cases, these instances do not seem aberrant, although they exert considerable influence in the tabulation. These atypical cases will be presented later, in Chapter X, with explanatory comment and discussion.

| Final Developmental Index | No. of Cases | Per Cent of Cases Whose Developmental Level Was Predicted on the First Examination | *Per Cent of Cases Showing a Range of Deviation Less than* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | *5* | *10* | *15* | *20* | *25* | *30* | *35* | *40* |
| 1. Below − 30 | 23 | 96 | 26 | 48 | 65 | 74 | 87 | 91 | 91 | 96% |
| 2. − 30 to − 10 | 19 | 75 | 21 | 37 | 58 | 74 | 84 | 90 | 95 | 100% |
| 3. − 10 to + 10 | 30 | 77 | 23 | 40 | 73 | 83 | 90 | 93 | 97 | 100% |
| 4. + 10 to + 30 | 15 | 66 | 0 | 13 | 53 | 73 | 87 | 87 | 87 | 100% |
| 5. + 30 and above | 3 | 100 | 33 | 33 | 33 | 66 | 100 | | | |
| Total | 90 | 81 | 20 | 36 | 62 | 77 | 88 | 91 | 93 | 99% |

| Final Developmental Index (*Final Developmental Rating*) | No. of Cases | *Per Cent of Cases Showing an Average Absolute Deviation Less than* | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | *5* | *10* | *15* | *20* | *25* | *30* | *over 30* |
| 1. Below − 30 | 23 | 43 | 78 | 91 | 95 | 100 | | |
| 2. − 30 to − 10 | 19 | 53 | | 100 | | | | 79 |
| 3. − 10 to + 10 | 30 | 60 | 80 | 100 | | | | |
| 4. + 10 to + 30 | 15 | 27 | 80 | 87 | 87 | 100 | | |
| 5. + 30 and above | 3 | 66 | 100 | 3 | | | | |
| Total | 90 | 50 | | 96 | 97 | 100 | | 84 |

### 6. THE PREDICTABILITY OF DEVELOPMENTAL TREND

To what extent can the movement of the developmental complex be predicted? This is scientifically a crucial

question; and, practically, one which constantly arises in diagnostic situations. Taken as a whole the data indicate a high degree of consistency in the course of early mental growth. Some exception must be made of the cases just mentioned, in which medical and social complications introduce disturbing factors in the developmental process and make it more difficult to gauge.

The table on page 147 shows that in eighty per cent of the cases the developmental rating made on the first examination corresponded to the final clinical estimate based on the total series of examinations. For the subnormal group of infants with developmental quotients less than seventy, the diagnosis was correctly made in ninety-six of the cases on the initial examination. The figures show that "superiority" is not recognized so readily. It is with present methods more difficult to diagnose in early infancy than "subnormality."

Because of the diversity of our data it is impossible to express degrees of predictability in any suitable mathematical formula. Some types of development will yield better to diagnostic estimate and therefore also to precision of prognosis. In the discussion of individual cases this variation in the certitude and definition of prediction will come to light. The age of the infant will also naturally influence the practical possibilities of prediction. There are special complications before the age of four months which will be subsequently mentioned.

The influence of chronological age upon the degree of deviation was calculated by deriving the correlation between age and the absolute value of the deviation: $r = -.21$ $N = 324$ $P.E. = .053$. There is apparently little relation between the two factors, and a rating made at four months is for predictive purposes as accurate as any rating made at

any age between four and twenty-four months. This statement seems to be statistically warranted; but is not made as a guide to practice. The necessity of carefully safeguarding all prognoses in regard to infant development, at the present stage of technique, is very great indeed. But our experience, borne out by the data, suggests that the immaturity of the infant, as such, offers no insurmountable barrier to judicious prediction. The perfection of method will ultimately make it possible to formulate general predictions as to trend and tempo of development in early infancy. Meanwhile it is best to rely on cumulative prediction, through the method of seriated examinations, and let the consistency of the series rather than the single examination shape the prognosis.

### 7. DURATION AND DEVELOPMENT

That age governs development is more than a truism. The relationship is one with profound implications, susceptible to endless investigation. In summary, our data give an affirmative answer to the question, Is development obedient to age? Not only does development require duration, but it defers to it. The cumulative evidence of the age ratings suggest that in infancy the demonstrable interdependence between age and maturity is highly consistent. No whimsical or fortuitous overlapping of, or transposition of, behavior pictures has been discovered. The normal five months child tends to behave like a five months child, and not like a four months or a six months child. Conversely, to an extent of great significance scientifically, chronological age can be deduced approximately from the behavior picture.

The deviation of subnormal and "advanced" infants, when it is observable, tends to be symmetrical and consistent.

The developmental complex, in spite of its manifoldness, tends to proceed as a whole, imparting a general trend and a characteristic tempo to its movement. When the complex is divided into motor, language, adaptive, and personal-social behavior aspects, these factors prove to cohere to a considerable degree. It does not follow that they are without a measure of autonomy. It is suggested that the variability of the factors is usually confined within normative age limits, so that marked irregularity is a special and relatively rare phenomenon. Nor does it follow that the slight irregularities or variations which occur in infancy are without importance. On the contrary they may be the basis of more conspicuous and significant individual differences in later life.

In all developmental complexes, even the most exceptional, there is a nucleus of ordered age progression of the phenomena. Exogenous factors modify and inflect the behavior picture, but they do not determine it. The obedience of mental growth to age probably is due to an intrinsic core of maturation, which is the matrix of the infant's behavior and the stabilizer of developmental trend and tempo.

The quantitative expression of the manifestations of mental growth is a problem which presents numerous theoretical and practical difficulties. The difficulties arise out of the fact that there is no genuine absolute measure of development such as we have for duration.

Physical growth can be expressed in grams and meters. Mental growth, with our present method, must be recorded in behavior values. They are so complex, and at present so irreducible, that one can formulate them only in relative, orientational terms, in a hierarchic kind of seriation. Recognizing the crudity of the device, one speaks of stages of growth, or levels of maturity. Then, to give numerical

status to these levels, they are normatively expressed in developmental ages; that is in months and years, mathematically precise units which psychology has borrowed from the ancient and exact science of astronomy.

The astronomer's month is derived from a physical orbit. Chronologically, a month is always a month. But the developmental month is derived from an organic cycle, and developmentally a month varies enormously, depending upon its relative position in that cycle, which probably bears more mathematical resemblance to the spiral than to an ellipse or circle.

A concrete illustration may be ventured. The usual child four to five years of age has just developed sufficiently to be able to draw a square; in two more years he will have developed sufficiently to draw a diamond. The typical infant of seven months can secure a pellet placed on the examining table with a palmar scoop; the typical infant of nine to ten months can pick up the pellet with precise pincer prehension, oppositing the thumb and forefinger. From an absolute point of view the distance (i.e. the psychomotor discrepancy) between the five year square and the seven year diamond is surely no greater than the distance between a seven months primitive scoop and a nine months human prehension. Let us call the distance between these levels of behavior a developmental increment. We are confronted with the broad suggestion that a two months increment in infancy may approximate a two year increment in later childhood. The higher the altitude on the developmental incline the slower the progress.

Minot has shown all this very strikingly in the field of physical growth. On a graph he plotted thirty vertical lines, to represent as many successive 10 per cent increments of weight in the child from birth to the age of eighteen. This

graph shows that the lines are most crowded in infancy, and that the space between them increases with age. Indeed fourteen, or nearly one half of the lines, are concentrated in the first three years. In other words "the older we are the longer it takes us to grow a definite proportional amount."

In the field of mental growth does not a similar proportionality obtain? The child's behavior is our only clue for an answer to this question, because behavior is a functional index of developmental status.

Granted that we have no accurate unit for measuring rate of mental development, is there any formula which will express, at least in relative terms, the incremental diminution which accompanies aging? There is, if we agree to state developmental maturity in terms of developmental age, and if we assume a constant relation between developmental age and chronological age. Let us express developmental agedness in months during the first year of life and in years after the first birth anniversary. We find, then, in terms of agedness, that we can plot the diminishing increments of development on a relative percentage basis. We simply bring each interval into comparison with the total preceding interval and we find a rapid stepping down of increments. In the second month the infant doubles his age; there is a gain or "increment" of 100%. In the third month, the increment is 50% (3 months: 2 months). In the fourth month it is $33\frac{1}{3}$% (4 months: 3 months). In the fifth month it is 25% (5 months: 4 months), and then in order, 20%, $16\frac{2}{3}$%, $14\frac{2}{7}$%, $12\frac{1}{2}$%, $11\frac{1}{9}$%, 11%, $9\frac{1}{11}$%, when the first year of the developmental cycle is complete.

We must now shift to larger units of agedness or we shall linger on a tedious plateau. Shift to year units, and we have a series of annual increments which arithmetically correspond to the monthly increments. In the second year the child

doubles his age. The series of percentage increments to the thirteenth year is 100%, 50%, $33\frac{1}{3}$%, 25%, 20%, $16\frac{2}{3}$%, $14\frac{2}{7}$%, $12\frac{1}{2}$%, $11\frac{1}{9}$%, 11%, $9\frac{1}{11}$%. (See Figure 42.)

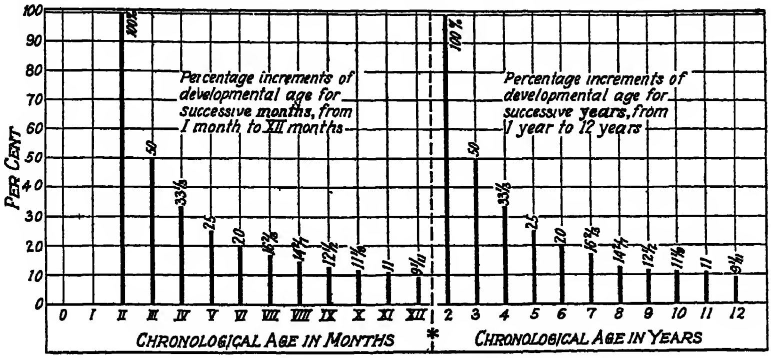



**Fig. 42.—Comparative chart showing the equivalence of eleven monthly increments of developmental age prior to the first birthday and eleven corresponding yearly increments thereafter.**

The beginnings and the end of the developmental span are extremely inaccessible; so we have simply brought into diagrammatic comparison or analogy, the monthly increments of the first year of postnatal life with the annual increments thereafter to the teens. We find that they are alike. If this method of formulating increments is reasonable, we are left with the broad conclusion that any year of development after the first birthday to the teens is comparable in its relative maturational value to a corresponding month in the first year of life.

From a clinical point of view such a comparative formulation may well be defensible. Clinical experience surely justifies the general statement that the younger the child the more serious is the prognostic significance of every degree of true retardation. Retardation, like a shadow, lengthens with the lapse of time.

This makes the determination of short shadows significant for the developmental diagnosis of infants. A month in infancy may have decisive dynamic importance in the developmental economy of the individual. Indeed, a constitutional retardation of only one month at the chronological age of two months may well signify mental deficiency.

## 8. THE GRAPHING OF GROWTH

The graphing of mental growth, therefore, requires some method of portrayal, which will bring developmental and chronological months into coördinate relation and which will not disregard the dynamic value of small units of time in the early phase of the growth cycle. To a certain extent this requirement is met by the widely used checkerboard grid with right angular Cartesian coördinates, illustrated in Figure 46. Following convention, this graph places the developmental and the chronological zero at birth. A straight line diagonal represents the ideal median course of development. A very small early deflection in the developmental curve, either above or below this median, becomes graphically magnified as age advances when the developmental rate is constant. Thus the apparently small retardation of two months at the six months level becomes a retardation of two years at six years. The advantage of this simple graphing is that it shows the potential importance of the small developmental interval in early infancy.

In spite of its simplicity, the method has certain disadvantages for the plotting of early mental growth. The area of the graph is restricted near the zero point. This leads to a crowding of the graphic lines near the place of origin, and permits the reader to overlook the significance of the slight deviations in this important developmental region. The normative growth line is a straight diagonal and is in no way

self-limited. It does not by curvature or otherwise suggest the attainment of maturity. Moreover, if a deviational line is prolonged beyond the locus of the natal zero, it transects the normative line and assumes a paradoxical position with reference to it. The ordinary Cartesian diagram is therefore rigorously limited by the natal zero.

There is a metaphorical, or purely representational, element in all graphing, and the above defects can of course be remedied by interpretive qualification. It seemed to us, however, desirable to find a method of representation which will comport somewhat more fully with the general characteristics of mental growth as expressed by the developmental level in its relation to the whole life cycle. Although the logarithmic curve extends to infinity in either direction, it appears to have certain advantages (as well as disadvantages) as a formal device for the plotting of individual graphs of mental growth.

The logarithmic method of plotting has been chosen for this present purpose because the logarithmic progression expresses the relative rate of incrementation, which is arithmetically implicit in the developmental age scale. The theoretical validity of the logarithmic curve as a growth curve *per se* need not now be considered, because we are confessedly using the curve for its formal graphic suitability. The basic principle of the curve is briefly discussed below.

The significance of the logarithmic method of plotting mental growth may be considered by a brief comparison with other available graphic methods. The general problem is to express the relationship between time and development. By defining development in terms of age, it is possible to treat this relationship quantitatively by means of equivalent, though not identical, time units. The chronological age units may be thought of as measuring duration

in an absolute sense. The developmental age units may be thought of as denoting genetic time values or levels in an organic, self-contained life cycle.

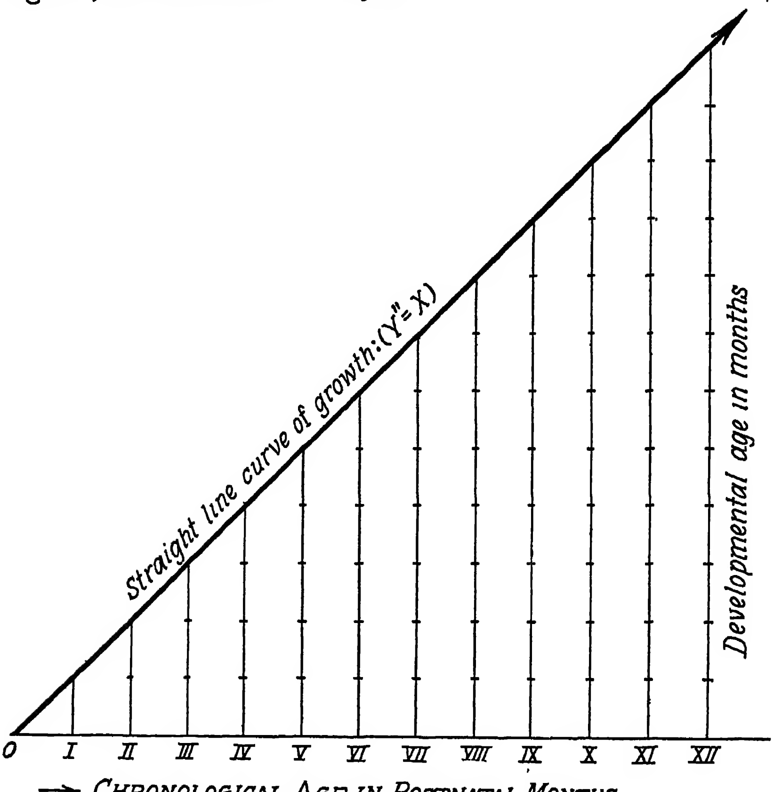



**Fig. 43. — Normative straight line curve of growth, based on Cartesian coördinates.**

If a series of developmental ages is graphed as an absolute series, on a chronological base line, the curve which expresses the augmentation of growth is the straight line diagonal, which is exemplified in the Cartesian grid (Figure 43 and

Figure 46). This curve represents a simple arithmetic progression for which the successive monthly percentage increments may be computed on a percentage basis as follows: 100%, 50%, $33\frac{1}{3}$%, 25%, etc. The equation for the curve is: $Y'' = X$.

If this arithmetic series of percentage increments is graphed on a chronological base line, the curve which

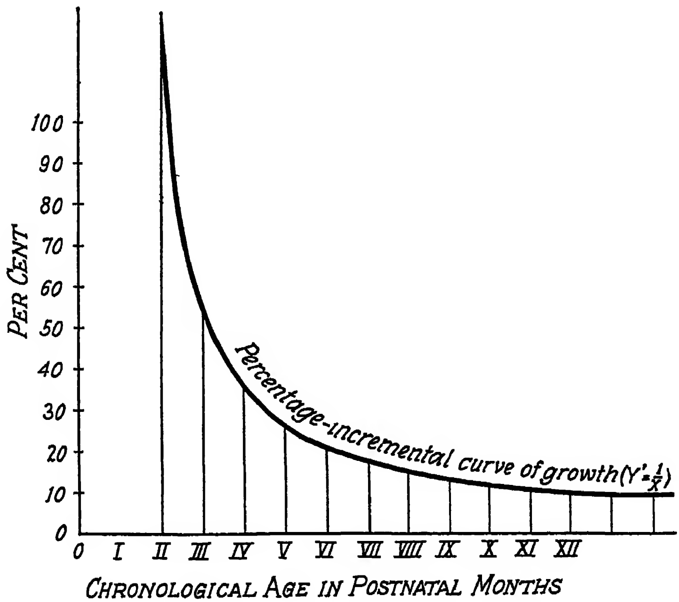



**Fig. 44. — Hyperbolic normative curve of growth based on serial percentage increments.**

expresses the incremental diminution of growth proves to be an hyperbola (Figure 44). The equation of this curve is: $Y' = \frac{1}{X}$, in which 1 equals a given unit of time, $X$ equals a total elapsed duration in the life cycle, $Y'$ equals the per-

centage increment of any specified unit of time.[1] This hyperbolic curve expresses the diminution or loss of growth increments, but does not express the cumulative and progressive characteristics of the growth cycle.

It is desirable to find a curve which expresses not only the negative acceleration of growth, but also the cumulative integrality of growth. Such a curve can be constructed by an analysis of the developmental age or genetic time values which are implicit in the hyperbolic curve. This analysis can be conveniently set forth by ascertaining the average percentage increase during any given chronological durational period (reckoned from the first time unit) and multiplying this average percentage value by the units of time in the given durational period. The values thus obtained may be expressed as ordinates on a chronological base line, and when these successive ordinates are erected, the loci of their summits plot what may be regarded as the developmental age curve of growth. This is a logarithmic curve.[2]

The accompanying diagram (Figure 45) illustrates the elements in the above analysis. Duration, or chronological age, is indicated at twelve monthly intervals on the horizontal axis. The accrued percentage of developmental age (genetic time values) corresponding to these durational units is plotted vertically. The equation of the resultant curve is: $Y = log\ X$. This logarithmic curve, because of its combined incremental and integral properties, is adopted as the

[1] Expressed in terms of calculus, $Y' = \frac{dy}{dx} = \frac{1}{x}$, or the rate of change of the percentage increment, is inversely proportional to the duration of time.

[2] Integrating $\frac{dy}{dx} = \frac{1}{x}$, in order to obtain the accrued percentage of time, results in $Y = log\ x + c$, where $c$ is a constant. If, when $x = 1$, it is specified that $y = 0$, then $c = 0$ and the equation expressi ; the cumulative integrality of growth becomes: $y = log\ x$.

normative curve of growth for graphing the deviations of development in infancy.

The individual growth graphs which will appear in subsequent chapters are constructed as shown in the illustrative diagram on page 161 (Figure 47). The horizontal

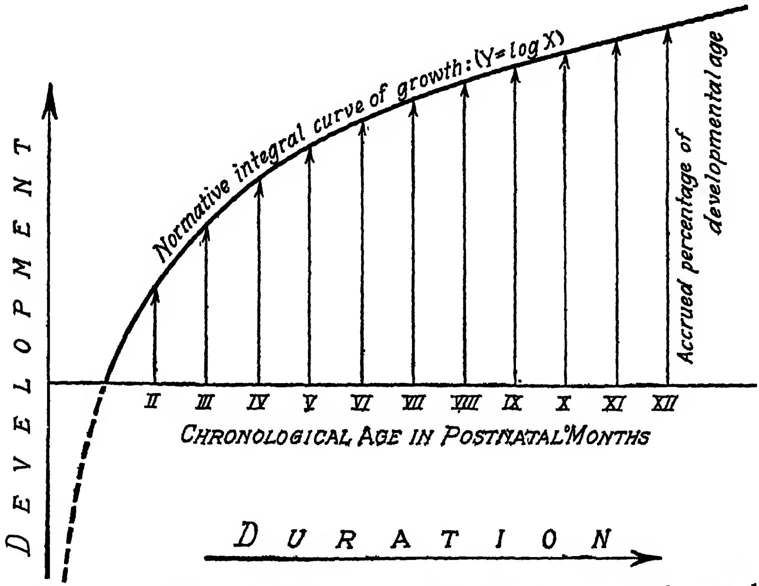



**Fig. 45.—Normative logarithmic curve of growth, based on total accrued percentages of developmental age.**

line in the graph is the basal time axis. It establishes the chronological age units beginning with the natal zero and extending from left to right toward maturity. The vertical axis carries the developmental units (maturity levels). In the vertical axis we plot the *logarithmic values* of the developmental units. The normative ideal average course of mental growth is therefore represented by a true logarithmic curvature (line *A*, D.Q. 100, in the diagram.) A consist-

ently retarded course of mental growth, (line *C*, D.Q. 75, in the diagram) is plotted below this ideal average curve.

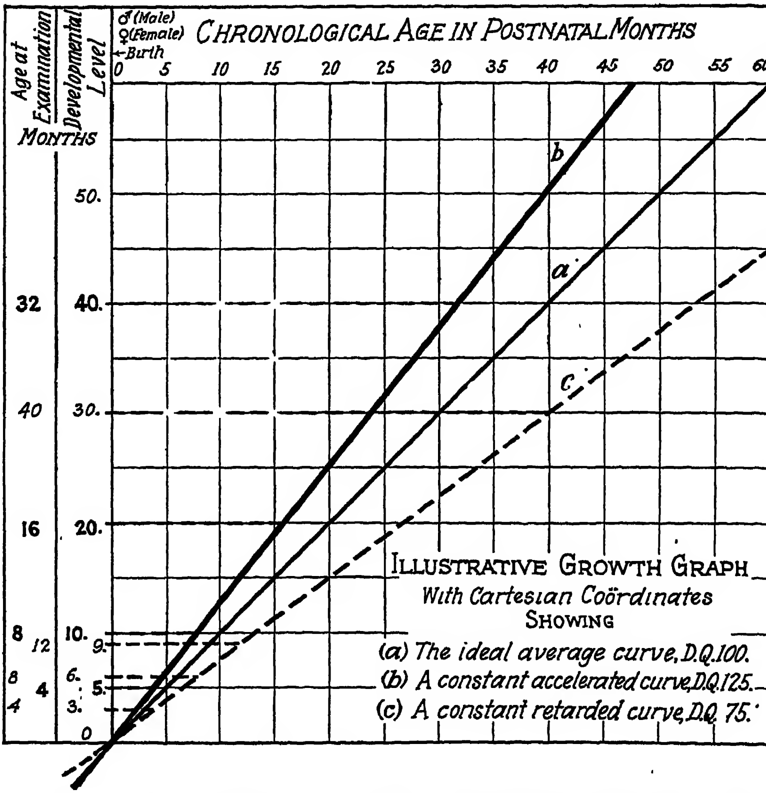



**Fig. 46. — Illustrative growth graph drawn with Cartesian coördinates, showing the crowding and paradoxical crossing of plotted curves, near the birth zero.**

The constancy of the retarded curve is represented by uniformity of the vertical distances between the retarded curve and the ideal average curve. Likewise for consistent acceleration, represented by curve *B*, D.Q. 125, in the diagram.

The logarithmic growth graphs may be read either horizontally or vertically. For convenience the plot point of each developmental examination is indicated on the graph

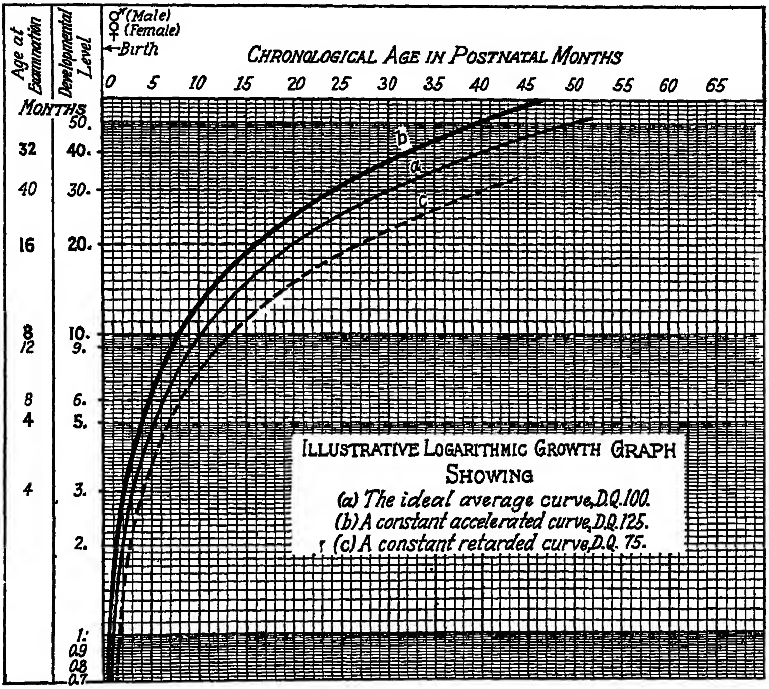



**Fig. 47. — Illustrative logarithmic growth graph showing constant deviations plotted on equal vertical distances from the normative curve (without paradoxical intersection on prolongation beyond the base line).**

by a spot mark. A horizontal line drawn from the vertical (zero) axis to this point will always represent the chronological age at the time of the examination. If the ideal average curve transects this line, the growth is retarded and the relative degree of retardation is indicated by the ratio

of the entire horizontal line to that portion of the line which lies between point of transection and the plot point.

If the horizontal line falls short of the ideal average curve, the growth is accelerated and the relative degree of acceleration is indicated by the ratio between a horizontal line drawn to this curve, and the distance between the curve and the plot point. By thus comparing the proportionate values in successive horizontal lines, the regularity of development may be inferred.

The growth graph may also be read vertically. The reader will then measure or estimate the vertical distance between each plot point and the ideal average curve. If these vertical distances all fall on one side of the curve and are uniform in their absolute length, then the retardation or acceleration of growth is constant. Plus deviations plot closer to the ideal average than corresponding minus (or retardational) deviations. The reader should be warned against the distortion of optical illusion in casual inspection of the logarithmic graph. The true mathematical distance of any given plot point from the ideal average can be determined only by critical scrutiny or by actual measurement along the vertical ordinates. A study of the illustrative graph will facilitate and safeguard the interpretation of the individual graphs which follow in later chapters. The sex of the child is indicated in the upper left hand corner of each individual graph: ♀, girl; ♂, boy. The ages at the time of examination and the developmental age ratings are indicated in the left hand margin of the graph.

The logarithmic graph has the following comparative advantages. It has a slope which suggests the swifter tempo of early development. It has a conformation which suggests the negative acceleration of maturity. It has a relation with the time axis which does not permit the para-

doxical crossing of curves mentioned in the discussion of the Cartesian coördinates. It gives more scope for plotting in the proximity of the natal zero, and preserves for the early months the intrinsic developmental importance which they tend to lose in a graph which is foreshortened by a rectangular grid.

The problem of the absolute zero is not without some importance in the theory and measurement of development. The logarithmic curve does not, of course, solve the problem for us; but it permits a consideration of the prenatal aspects of the growth cycle, which were assumed to be constant for the purposes of the present chapter. Prematurity of birth raises critical questions concerning the true location of the chronological and the ontogenetic zero. A later chapter (XV) will inquire into effect of such premature birth on the trend and tempo of the infant's development.

# CHAPTER VIII

## NORMAL AND RETARDED DEVELOPMENT

### Individual and Comparative Studies of Developmental Tempo

There is a vague generalization which suggests that all infants are very much alike, inasmuch as they are but infants. This generalization is benevolent enough; but it is a careless one. When it is modified to assert that infants are much more alike than adults, it seems more defensible; but even in this form the statement needs to be critically tested. It may not be as near to the truth as the postulate that infants differ individually to the same degree that adults do.

If the specific abilities of infants were tested and measured, as abilities, we should probably discover more differentiation than is apparent beneath the surface of similarity. Still more significantly, infants differ in the manner in which they grow. This is in a sense the most fundamental and inclusive of all human differences. A mode of growth expresses a primary biological character, determined by the ancestry and the physiological make-up of the infant. Food, training, experience, and disease all play a rôle in the maintenance and organization of the changing growth-complex. Every individual therefore represents a unique growth-complex; for these factors, biological, cultural, and medical, can never fall into precisely the same pattern even in twins. The patterns, however, are shaped according to developmental laws which apply equally to all types of humanity.

We shall assemble in this and following chapters a diversity of individual growth studies to illustrate both usual and unusual genetic patterns. The more exceptional deviations serve to emphasize the balanced ordering which underlies the more common manifestations. The individual growth graphs will serve as texts for brief characterization and general comment.

### I. A NORMAL, MEDIAN MENTAL GROWTH CURVE (4 MONTHS TO 24 MONTHS)

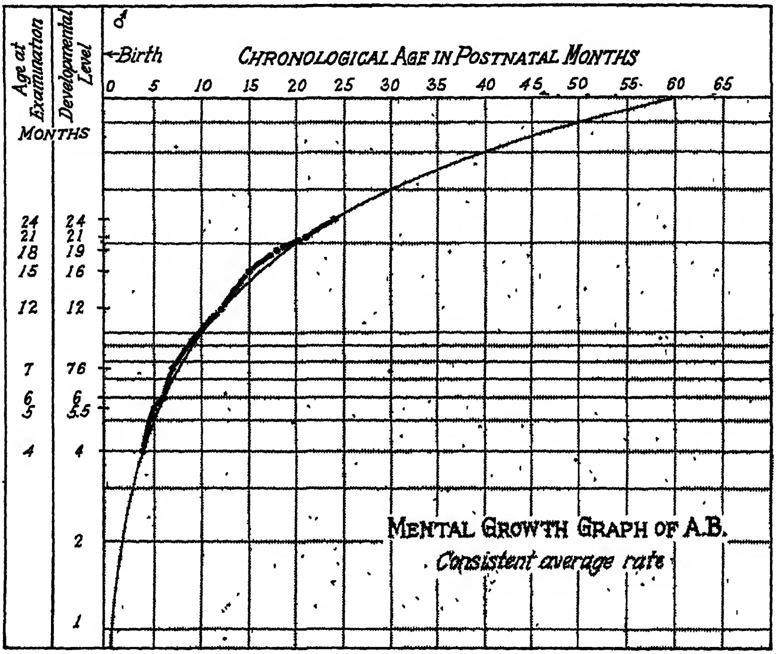
The first graph in this series is that of an infant boy, A.B. He is representative of the most numerous group of infants, namely the healthy, ordinary group whose course of early development plots close to the normative median curve. Such a "normal" curve serves as a standard of reference for the study of both minor and marked deviations.

This boy, (A.B.), was first examined when he was 4 months old. He made an excellent showing on the developmental schedule for that age, scoring success on 24 out of a possible 26 items. The notation made on the clinical record at that time is interesting in the light of the eight subsequent examinations: "Impression is very definitely one of fully average endowment. Responses have not the quality of vividness or immediacy noted in certain cases where superiority is suggested; though the quality of the attention is good and the baby is normally reactive." — This impression has been steadily sustained by eight periodic examinations. He is now two years of age.

The expressions "good quality of attention" and "normally reactive" may be forgiven. They sum up conveniently the clinical appraisal of the vigor, promptness, coherence, and adaptiveness of his general behavior picture. He regarded the dangling ring intently, closed in upon it with both hands;

he kneaded and scratched the table surface when his hands were rested upon it.

In another month he turned his head to listen to a bell rung near him. In yet another month he picked up a cube




Growth Graph 1.

on sight from the table top. To continue to list in detail the increments in his development would be to take another unnecessary journey through the normative schedules. In counting up the entire array of normative ratings, which were definitely made during the series of 8 examinations, I find that the total number is 224. On these graded items he has remained very near the norms appropriate for each

successive stage. He was given an ample opportunity to succeed on the items just a bit beyond him; but he preferred to pass these on the next succeeding examination!

When he was 21 months of age we brought him into psychological comparison with another vigorous, sturdy boy, age 18 months (J.K.), whom he so much resembled physically that one was readily confused with the other. An item for item comparison (on 33 items) was made between these two boys and brought into relief a startling degree of similarity in behavior. In block building tests, in language, and in drawing, they stood at the same level, as shown by common successes and common failures. For both children the imitation of the vertical line was still too difficult, and neither of them distinguished satisfactorily between the stroke and the circle. Associated with this extensive similarity was a superficially concealed difference of three months in age, which may have much significance from the standpoint of developmental mechanics. The predictive import of such an age difference will be considered later. Discussion of this accelerated boy likewise belongs to another chapter. The "normal" infant with average outlook tends to cling more closely to the median path.

How long will A.B. cling to that path? He is only two years old now. He has many years left in which to grow. It may be true that he has traveled near the average thus far; but give him his chance! Too little is known about the problem of mental growth to permit unqualified prediction; but it may be urged that from the developmental point of view this boy has had a great deal of chance to display either superior or inferior deviation in his growth characteristics. He has not done so. In a relative sense he has undergone a very important part of his fundamental growth. The best general index of future development is attained develop-

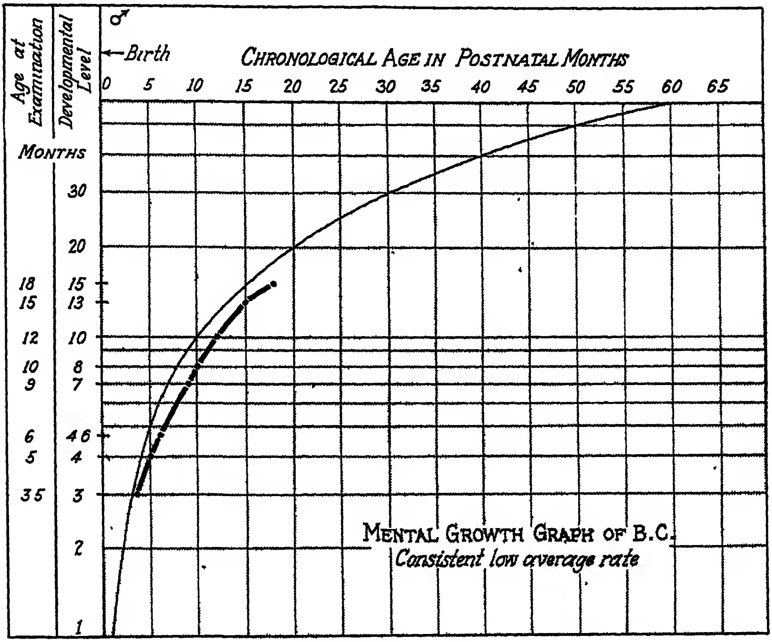
ment. His attainment has been consistently high average in quality and scope. And though he is but two years old, the eight examinations already made cover as much developmental ground as will an equal number of annual examinations in the next decade. It is certain that under ordinary circumstances this infant will not, as a youth, prove inferior in his general capacities.

In the field of development it is difficult to consider any topic purely on its own merits. To speak of the "normal" in terms of the normal is tautological. Already we have introduced an accelerated infant into the discussion to reveal the significance of the median. It will be profitable for the same reason to graph the developmental course of an infant who shows a comparable deflection from the middle course, but in the opposite direction.

### 2. MENTAL GROWTH OF A LOW AVERAGE TREND (3 MONTHS TO 18 MONTHS)

This case is perhaps, all the more significant because from his early babyhood B.C. has worn an aspect of wholesome, ordinary normality. He is physically well developed and has besides a winning temperament. He became something of a favorite in the children's building to which fate brought him; and was singled out for adoption by an eager young couple who were anxious to rear him and give him the best possible education. Fortunately he is a "normal" child and is quite entitled to placement in a foster home with a view to ultimate adoption. But with regard to the question of college educability, the outlook has become increasingly dubious. He has maintained a steady pace of development, but it has been pitched consistently on a *low* average level. The whole complex of mental growth has now assumed an import away from college educability rather than toward it.

This statement is made for its descriptive value, and not, of course, to suggest any rigid classification or procedure which would in any way prejudice his opportunities in life. It




**Growth Graph 2.**

must, however, be recalled that the prospective adoptive parents did themselves formulate the criterion of college educability.

This boy, B.C., was examined seven times during the course of the first year of his existence. For convenience we shall discuss the results of these examinations in terms of developmental quotient. When the child was 3½ months of age the general developmental level was rated at 3 months. In other words, there was a slight question of complete

normal maturity at that age. If this rating represented genuine accuracy, we should have developmental ratio of 3 to 3½ and in percentile terms a developmental quotient of approximately 85. It is significant that a mild degree of retardation did suggest itself at least at this time.

On the next examination, at the age of 4½ months, he was rated at a low 4 months level. At that age it was still clearer that the child was not rating at his expected level.

On the third examination, although the child was 5 months of age, he was rated as being at the 4 months level. This yields a quotient of 80. At the age of 6 months a slight gain was noted. At the age of 9 months the level approximated 7 months.

In 6 months of time a half month of retardation has lengthened into two months. The developmental quotient has gravitated toward the 80 to 85 zone.

Another reëxamination was made at the age of 10 months, at which time the child rated very consistently at the 8 months level. Here again we have a developmental quotient of 80. At the age of 12 months the developmental level rated consistently and coherently at 10 months.

Plotting these results on a mental growth chart, we see a definite tendency for the curve of mental growth to project itself on a low average level. The general consistency of the findings points to a classification of low average endowment. There are, however, interesting theoretical and practical qualifications to be noted. An inspection of the ratings on original schedules for seven successive examinations showed considerable tendency toward constellation of ratings. This constellation is sufficiently consistent to suggest relative constancy in the development quotient. We find, however, from the tabular summary, that in the interval from 9 months to 12 months chronologically, the child has made, develop-

mentally, a gain of from 7 months to 10 months; that is to say, 3 months. How is it possible that a child whose development is proceeding at a subnormal rate can make a gain of three developmental months in three chronological months, and still deserve a diagnosis of mild retardation? If we were dealing with absolute units of measurement, this paradox could not be explained. We are, however, dealing with relative concepts and by hypothesis do not regard all developmental months as having the same behavior value. The paradox may therefore be rationally resolved.

In the last quarter of the first year of life this child is accruing the development which is appropriate to the third quarter, but inasmuch as the speed or current volume of development is greater in the third quarter than in the fourth quarter, he has not, in this last lap of his developmental journey, made a normal gain. It is impossible to equate chronological and developmental months unless they are equated in a serial and dynamic sense. It is for this reason that a child in the first year of life may be proceeding at a subnormal rate, even though in three months he may be scoring a gain of three months on his developmental schedule.

The significance of small durational units and of small developmental increments in the first year of life is therefore clearly indicated in the case before us. Precise developmental measurement at the time of the first examination would have required an instrument capable of measuring developmental status to a refinement of two weeks. The importance of accurate *chronological* age also is illustrated in the present case. We might easily assume, since the child was born out of wedlock, by a mother less than fifteen years of age, that there is a complication of prematurity. If this child was born prematurely, to the extent of one month, the developmental outlook is appreciably altered, even at the

age of twelve months, and after seven periodic developmental examinations. The outlook is improved because the child is then, after all, not one year old, in the biological sense, but only 11 months old, and therefore the developmental level of 10 months does not represent an equally serious discrepancy.

There are other qualifying factors. This child was never seen by his mother, and had lived, without interruption, in an institution during the first year of his existence. We should raise, for scientific reasons, the question whether this mode of life has not definitely retarded his language development and perhaps his adaptive behavior as well.

To some extent this question has been answered. For a full half year he has enjoyed the kindly treatment and management of a good family home. He was examined again at 15 months and at 18 months. Although he retained his attractive, responsive personality, there was no definite improvement in the behavior picture. He is not a full average, alert, perceptive, exploring eighteen months runabout. His limitations are revealed not only by the schedules but by his playground behavior when he is brought into vivid comparison with his chronological peers.

This case has been discussed in terms of the developmental quotient to show the exacting nature of age formulae in early infancy. At the age of 15 months this child most closely approximated the 12 months level. This ratio yields a quotient of 80, which is a fair characterization of our clinical estimate. If on the basis of a few scattering successes he had been rated 13 months, the apparently slight difference would have advanced the quotient up to 87. This is not a negligible difference from the standpoint of clinical description or prognosis. It is evident that psychometric formulations must be made with unrelaxing caution until

instruments of great precision are available. The months are as vast as the years in infancy.

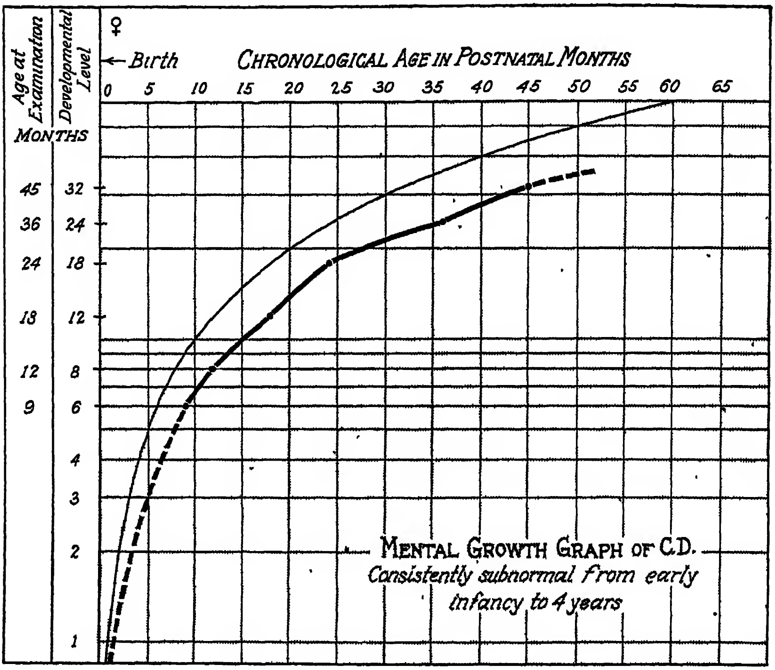
At the age of 10 months, it will be recalled, this boy approximated with much coherence an 8 months level of behavior. It happened that on the afternoon of the day following his examination an infant chronologically 8 months of age, came to the clinic also for a developmental examination. Here was a promising opportunity for comparison. We anticipated that we should bring developmental equals though not age equals into parallel view. The expected did not happen. The new baby rated consistently at the 10 months level, and we were left with two highly contrastive ratios, one the genetic reciprocal of the other:—developmental 8: chronological 10 *versus* developmental 10: chronological 8. Is this disparity an everyday symptom of ordinary variability in infant development? Is it a passing consequence which will be neutralized as soon as the development of both of these infants has settled to an equilibrium? When does infant development settle to its trend and tempo?

### 3. EARLY MANIFESTATION OF PERSONALITY TRAITS AND MILD RETARDATION (9 MONTHS TO 48 MONTHS)

The case of B. C. which has just been discussed falls clinically within the zone of normality. In the present case, C. D., there is a similar picture of retardation, associated with agreeable personality, but the clinical classification is border-line subnormal. The mental growth of C. D. is plotted in Graph 3. The history of this girl is perhaps more convincing because we are able to extend it to the age of 4 years, and there can be no reasonable doubt that the child will fail to attain an average level of normality.

C. D. was first examined at the age of 9 months. At that

time she had every outward appearance of being a normal infant, in countenance, in responsiveness, and general reactiveness. Indeed her amiable personality cast a spell, and has consistently exhibited traits which tend to conceal




Growth Graph 3.

her fundamental limitations. On the developmental examination, however, these limitations were revealed. She rated coherently at the 6 months level. This was 4 years ago, and we felt at the time that this child, being so near the border-line of normality, would become a good test of the permanence of retardation and of the predictive value of the developmental rating.

Was this retardation of only 3 months a negligible lag which would soon be made up and lost in a few years? It has not proved so. The personality characteristics which were first noted when she was not able even to sit up have persisted; but so has the relative retardation. The lag of 3 months lengthened into 4 months at 1 year, into 6 months at 2 years, into 12 months at 3 years, and into about 15 months at 4 years. The developmental quotient of this child has gravitated between 70 and 80. In Chapter XI (see Figures 49, 50) reference will be made to the development of drawing abilities in C. D.

This case is one of the most completely documented in our files. All told, the records list 180 individual ratings, and the ratings show a high degree of internal consistency. They demonstrate that *mild* degrees of retardation bordering on the lower level of normality can be detected at least as early as the age of 9 months. Numerous action photographs were taken at successive examinations and these serve to support the clinical record of mental growth which was made.

In reviewing the collection of photographs we find that they are particularly striking in the consistency with which they portray the underlying personality of C. D. On the very first examination the attractiveness of this personality was felt. She was benign, good-natured, socially responsive. There was no timidity, no irritability, and an untiring amenability. The developmental examination and the photographing were accomplished with ease; and so far as readiness of rapport was concerned the examination might have gone on indefinitely. There was much smiling, and a genial outgoing attentiveness to the persons in the examining room.

All this was at the early age of 9 months. In spite of a somewhat checkered career in institutions and boarding

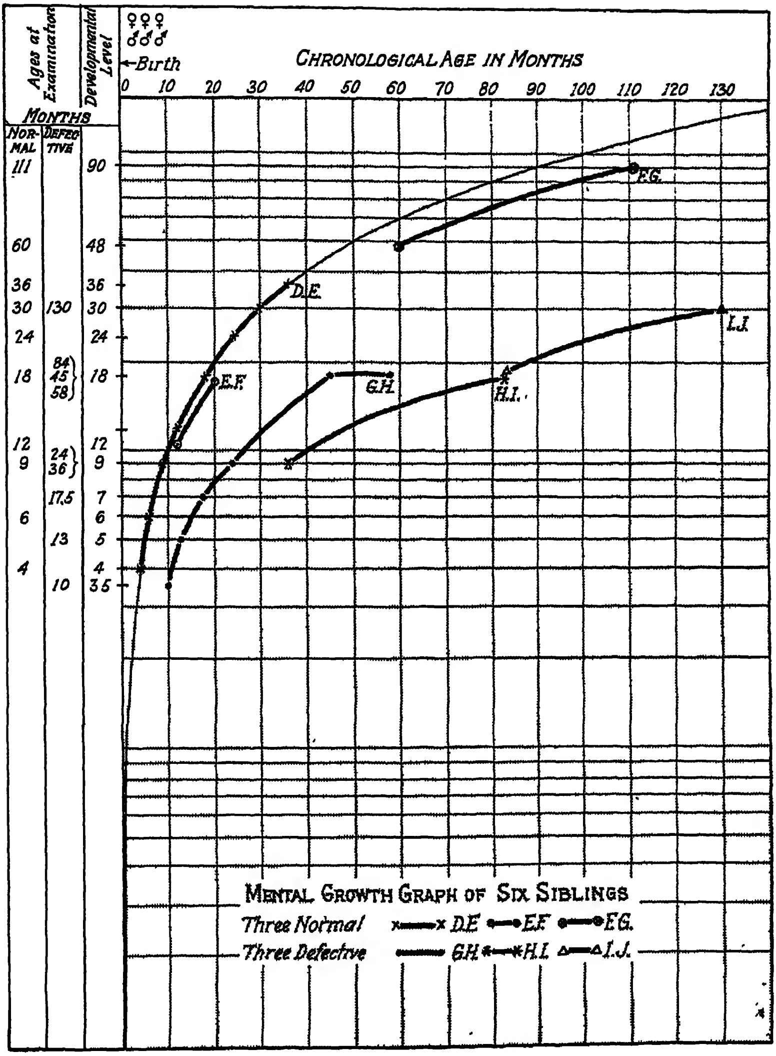
homes, these qualities have persisted. A slight timidity has crept into the behavior picture; but the same characteristics of good-natured sociality remain in evidence. At the age of 4 years these characteristics, not being offset by vigorous personality traits, begin to wear an aspect of subnormality; but in the period of infancy they imparted a more favorable suggestion. Indeed, at the age of 9 months, it was difficult to think that this child was in any way inferior. Her physical appearance, her general reactiveness, and her emotional responsiveness, all conspired to convey an impression of normality.

The performance on the developmental schedule, however, showed a record of symmetrical retardation. She was developmentally much nearer to 6 months than to 9 months maturity. She reached for objects, she played with blocks, she crumpled paper, she manipulated a spoon, she picked up a pellet; but the quality and the coördination in all this behavior bespoke a retardation of about 3 months.

The degree of retardation has remained highly constant, and clinically her status is now so well defined that the future school career and social capacity are indicated in general outline. Her personality will be an asset while she is being trained, and she will respond to a practical, non-academic type of education. These facts were implicit in the nine months behavior picture of this child, in spite of a strong simulation of full normality.

### 4. SIX SIBLINGS; THREE NORMAL; THREE RETARDED (4 MONTHS TO 11 YEARS)

Graph 4 assembles the growth graphs of six children who are brothers and sisters. It is evident at a glance that normal and retarded are here brought together in strange juxtaposition. For three of the children the developmental




Growth Graph 4.

curves lie close to the median (D. E., E. F., F. G.). For the remaining three the curves fall far below the zone of normality (G. H., H. I., I. J.,). In physical make-up and countenance all six siblings appear normal.

The aggregate chronological age of these six children is 36 years. The aggregate developmental age, if the separate ratings are compounded, is 17 years. Such statistics are crude but they serve to epitomize quantitatively the import of the total picture. The combined chronological age of the normal children is 13 years, and their ratings add to 12 years, not an alarming discrepancy. But the combined chronological age of the retarded children is 23 years and combined attained developmental age is approximately 5 years.

It is not our task to discuss the social significance of the state of affairs represented by these figures. That there is a neuropathic hereditary factor can scarcely be doubted even though the mother manages her household and the father is regularly employed. The high degree of similarity between the three retarded siblings is strongly suggestive of a common genetic factor, since there is no history of illness or injury to account for the mental deficiency. The three normal children likewise are developing in much the same manner, and are clinically classifiable as of low average intelligence. The whole group of children have lived together and continuously in the same environment. There is no ascertainable extrinsic cause to account for their differences.

The fact that there is such a definite bimodal distribution of normal and subnormally retarded types of development in this one family is perhaps of some general significance. It is suggested that growth potentiality is not determined by a compromise or quantitative blend of two strains; but is rather the expression of discrete ancestral contributions.

These six children are evidently derived from two distinct

stocks, and though all bear a family resemblance in feature and are normal in appearance, one group is handicapped by an abnormal reduction of growth potency. This reduction is so fundamental that it has retarded the realization of growth in a symmetrical manner. In spite of their pathetic handicap these retarded children give one the impression that if they could grow a very long time they might yet achieve more than outward semblance of normality.

# CHAPTER IX

# ACCELERATION AND SUPERIORITY OF EQUIPMENT

## The Symptoms of Giftedness in Infancy

By accelerated development is meant a quickened tempo as measured by age norms. Such an increase in velocity changes the trend of the developmental curve and raises interesting, though difficult, questions concerning the ultimate altitude of the more steeply climbing path. Is the span of the cycle of mental growth thereby changed? Is the upward deflection of the curve also associated with a dynamic or qualitative alteration of the total behavior complex? Is the alteration in the nature of an augmentation or of a diminution of the behavior stream? Is there a penalty attached to precocity?

These questions are too complicated to permit of simple generalization, and data in regard to them are meagre; but they impart added interest to the cases of infant precocity which have come under our observation. There is virtually no literature on the psychological aspects of this problem. Mythology credited the infant Hercules with amazing feats Similar tales occasionally find a home in the newspapers. Likewise there are fragments of lore pertaining to prodigious infancy in the pages of pious biography. It is noteworthy, however, that Terman and Cox in their exhaustive investigation of the biographes of genius, record almost no facts

relating to the period of infancy, with which we are here concerned.[1]

### 1. BIOGRAPHIC DATA REGARDING THE INFANCY OF EMINENT MEN

Among Miss Cox's biographic summaries of 292 men of genius there are only fourteen cases containing data of any sort regarding the period of infancy up to two years of age, while there are sixty-three additional biographies which give data concerning the period from two to six years of age.

Of the fourteen cases furnishing infantile data there are only five cases which give items of any positive significance from the standpoint of development. The items are of unequal reliability, but they are interesting and readily summarized:

Torquato Tasso, writer, is said by historians to have spoken words clearly at the age of six months and to have thought and reasoned at that time. He began the study of grammar at three and soon took up letters and humanities.

Sir Humphrey Davy, scientist, walked at the age of nine months, and could speak fluently before two years of age.

Henry Peter Brougham, statesman, from mere infancy showed a marked attention to what he saw before he could speak. At eight months he spoke several words distinctly.

Friederich Wolf, scholar, was taught to enunciate clearly before the age of two, began to write and study music at the age of three, and remembered back in later years to the age of two and a half years.

Thomas Carlyle, writer, had not spoken a word until eleven months, when hearing a child cry he said, "What ails thee,

[1] Cox, Catherine Morris, *Genetic Studies of Genius*, Volume II (edited by Lewis M. Terman), Stanford University Press, Stanford University, California, 1926; p. 842.

Jock?" Parenthetically, it may be pointed out that this represents a high degree of acceleration. This type of sentence is not ordinarily found in children until the age of eighteen months to twenty-four months. We have clinically encountered only one instance of comparable language precocity, and this in a girl who at the age of eight years had an adult vocabulary and the highly exceptional intelligence quotient of 180.

Jules Mazarin, statesman, at birth had hair and two teeth, while the Earl of Clarendon, statesman, cut his first tooth at nine months! Gabriel Riquetti, Comte de Mirabeau, had two teeth already cut when born.

It is perhaps noteworthy that George Sand, writer, although she walked at ten months, began to talk "rather late" and could not spell correctly at seven.

Jerome Cordan, scientist, suffered from plague at the age of one month, was reared in a squalid hut, and was undernourished.

In the group of cases reporting biographic data for the period from two to six years, there are many instances and items which connote accelerated development. We may well believe that children who begin to read and write with some fluency at the age of three years had exhibited, unnoted, many evidences of precocity before that time.

Coleridge could read a chapter in the Bible at three. Voltaire at three learned to read from Fontaine's fables. Albrecht von Haller, scientist, delighted in making books and financial accounts and dictionaries beginning at the age of three years. Macaulay had ceased to care for toys at the age of three, but liked walking and telling stories. John Stuart Mill learned Greek at three. Jonathan Swift could read any chapter in the Bible at three and had learned to spell at four. F. W. von Humboldt was taught to read and

write at three. Likewise Christopher Wieland, who in later life recalled a walk taken before the age of three.

Oliver Goldsmith breaks the symmetry of this series, for although he attended a dame school at three, it was reported "there was never so dull a boy." Ralph Waldo Emerson attended a dame school before the age of three and exactly at the age of three was reported as "not reading very well." Emerson's own children, however, their Aunt Mary always insisted, "knew how to read before they were born."

In spite of the paucity of data concerning the period of infancy, there is ample evidence that extraordinary ability tends to be associated with precocity in childhood. Whether this precocity is actually manifested in the first two years of life is the question at issue; and is of course a profoundly significant question for the science of growth.

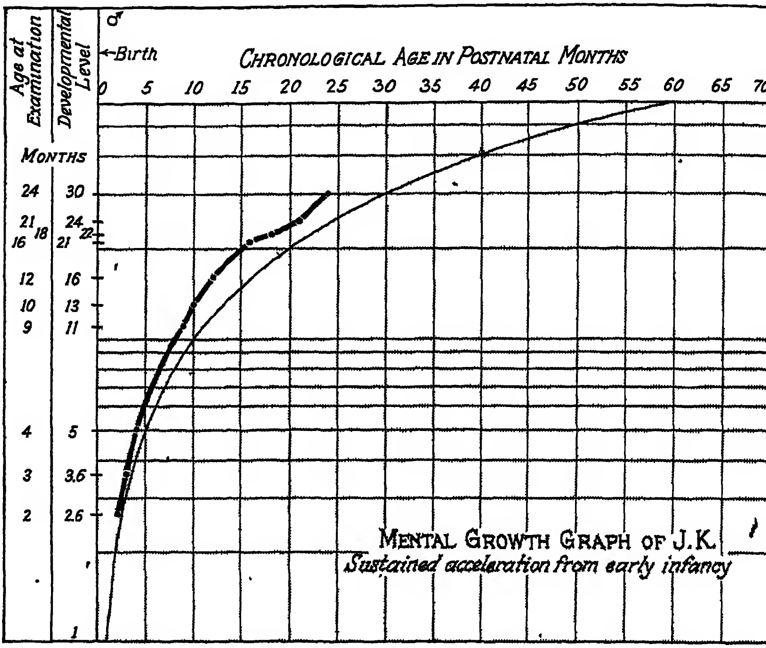
### 2. A CONSISTENT CASE OF ACCELERATED MENTAL GROWTH IN INFANCY (2 MONTHS TO 21 MONTHS)

We are obliged to turn from fame-resounding names to clinical cases, which must of course remain anonymous, although they may well include one or two infants who will yet find their way into a biographical dictionary!

From ordinary walks of life came J. K., the eighteen months infant who was brought into psychological comparison with the twenty-one months old infant, A. B., (page 167) to emphasize the developmental mediocrity of the latter. He (the junior infant) may again serve as a point of departure. By the developmental schedule he showed, at the age of a year and a half, a definite acceleration of three months, reckoning from the median boy as the standard. How far will this acceleration project itself into the future? The gift of prophecy alone could vouchsafe a conclusive

answer; but one may venture a more feasible and no less pertinent question: How far has this acceleration manifested itself in the past? Fortunately our data are more than ordinarily clear on this point.

*First Examination (Age two months):* The first examination of J. K. was made at the age of two months. A high average




Growth Graph 5.

development was suggested at that time and noted on the records. Entry was made of the fact that he showed strong selective regard for the examiner's face, looked at it steadily for fully two minutes, and also responded with a "social" smile. "Alert and responsive" was recorded in the column for personality characterization.

*Second Examination (Age three months):* At three months this favorable impression became strengthened and defined. The entries read, "Child's motor development advanced," "Quality of attention vivid," "Appears to have strong drives." The record blank carried a space for recording *Personality and Ability Forecast.* The following entry was made in this space: "Strong, vigorous baby, well handled, personality should be forceful and well equilibrated." It was noted, however, that the child was highly conditioned in a motor sense, since the mother had given him simple exercises during the dressing periods regularly almost since birth. It was difficult to put the child in a sitting position because he was so conditioned to standing and pushing with the feet while held by the mother. When the baby was on his back, the mother bent the knees; he pushed against the palm of her hands and thus progressed across the table. (These exercises are not mentioned for imitation without medical advice!) The baby's muscular tone was excellent and he enjoyed this physical activity. Definite hand inspection and vigorous reaction to the table edge were noted as advanced reactions. Motor performance compared favorably with a five months level of development.

*Third Examination (Age four months):* The developmental ratings were consistently high on this examination. The baby was credited with every item on the four months normative schedule and with all but one item on the five months schedule. This is an unusual showing and has been rarely encountered in our experience.

At this time J. K. was definitely picking up objects from the tray of his high chair; he vocalized desires vociferously; he had begun experimental sound play. He was already partly trained and regularized with regard to bowel habits. Sitting was now his preferred position and he could sit

alone momentarily when favorably placed. The motor control was so extraordinarily good that it was suggested that perhaps this fact was influencing our clinical impression; but it seemed that the adaptive behavior also was definitely advanced. It is so recorded in the growth graph.

*Fourth Examination (Age nine months):* It was impossible to see this child again until he was nine months old. Monthly incremental ratings undoubtedly would have revealed consistent acceleration; for at the age of nine months he had reached almost a twelve months level of maturity. He articulated three words (ma-ma, da-da, bye-bye). He adjusted a round block to the form-board. He repeated performances laughed at. He inhibited certain acts on command. Bowel and bladder control were so well regulated as to earn a rating on the fifteen months level.

The motor abilities were again in evidence. He stood alone a moment without support; he walked holding the examiner's hand; he lowered himself from a standing to a sitting position, slowly and carefully without support. When the formal examination was over he entertained us with a wheelbarrow stunt and somersaults.

*Fifth Examination (Age ten months):* In a month he made easily perceptible gains. He had added two more words to his vocabulary; he walked alone, and climbed a chair. He was descriptively rated at the fourteen months level. The clinical summary recorded: "Impression of superiority strongly reinforced. Reactions quick. Quality of attention good."

*Sixth Examination (Age twelve months):* This examination marked his first birthday; but on the developmental schedules he had to be scored by fifteen months and eighteen months normative items. He had travelled well beyond the behavior zone of the normative twelve months infant. His

vocabulary had swelled to six words. He pointed on direction to his nose, hair, and eyes. He filled a cup with blocks in spontaneous play. He attempted to build a tower of three blocks. These items are varied and significant enough to give him a clear lead over an "average" child. For the fifth time the acceleration is confirmed and written into the cumulating evidence.

*Seventh, Eighth, Ninth, Tenth Examinations* (*Age sixteen, seventeen, eighteen, twenty-one months*): These examinations will be summarized together. They are consistent with each other, and with all that have preceded, in their revelation of accelerated development. At sixteen months the child's vocabulary was easily a dozen words. At seventeen months this list had doubled. At eighteen months, a dozen and a half more phrases and words were added. Similar gains were made in other fields of behavior. His interest and skill in climbing feats were amazing. He could readily be rated on the two year level in the motor and personal-social behavior fields. In the general field of adaptive behavior he deserved a high twenty-one months rating. As we have seen he was on a par with the vigorous medial infant, A. B., of that chronological age with whom he was brought into itemized comparison.

There can be no doubt about the consistency of the acceleration of mental growth in this boy. This acceleration was manifest at the second month and has been so sustained that it must be considered a true biological phenomenon. It is such a distinctive departure from the typical tempo of development that it cannot be dismissed as a negligible individual difference. It denotes either a distinctive physiological modality of development or that kind of intensification of ordinary development which heralds superior ability in youth and maturity. If we use Spearman's concept of

mental energy, "g," we may see in this vivid, direct, animated infant a more than ordinary fund of dynamic power, excellent "engines" and a good "engineer." From the beginning this child has impressed us as being extraordinarily well constituted. The unusual motor training which he received so early in his career cannot altogether be left out of the accounting; but it is scarcely adequate to explain the total behavior picture.

### 3. THE DEVELOPMENTAL OUTLOOK OF ACCELERATION

Time alone can provide the evidence for a full interpretation of the bionomic significance of this infantile precocity. Its effect upon the later, adult sectors of the mental growth cycle is, from the standpoint of psycho-biology, the most interesting question of all. If we could but cast a horoscope to satisfy our curiosity in the matter! As the evidence stands we content ourselves with listing four major possible issues to which this precocity is a prelude:

(*a*) This acceleration is an untimely ripening; it is essentially abnormal and therefore will lead to premature arrest or curtailment of development. The precocity bodes ill.

(*b*) This acceleration is simply a freak in the ordinary time-growth relationship, neither wholesome nor unwholesome. It is an accidental nonconsequential variation and will not in any way interfere with the child's future. He will realize his endowment, large or small, irrespective of his developmental tempo. The road is independent of the rate of travel.

(*c*) The precocity is largely motor and not fundamental. It presages an energetic, executive, motor-minded individual who will make a success in certain practical fields, but will otherwise classify as an ordinary or average person.

(*d*) The precocity is part of the child's biological endow-

ment and not an incident. It represents a positive growth potency, as well as an accelerated rate of function; and is a dynamic factor in the creation of drive and in the maturation of a relatively superior order of abilities. What retardation is to inferiority, this acceleration is to superiority.

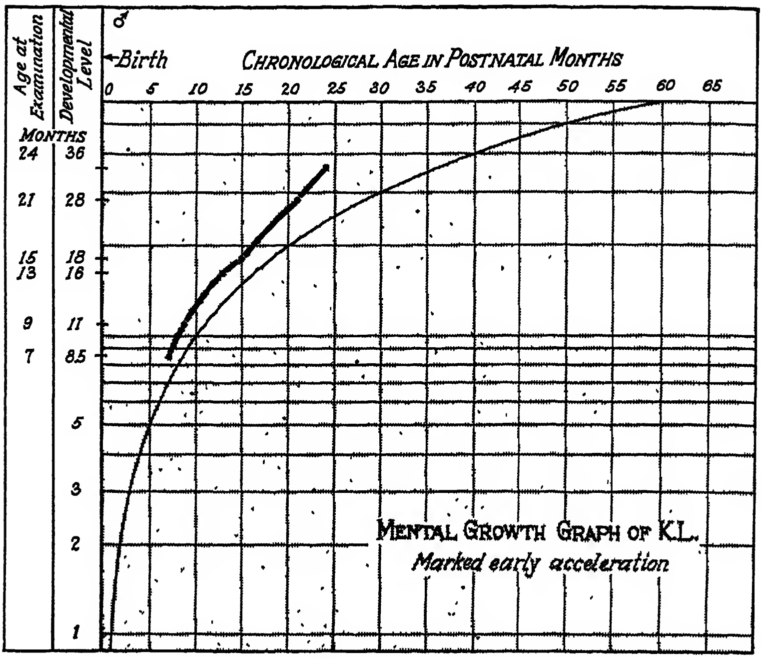
These four possible issues have been listed, we hope, in an ascending order of probability. The superiority of J. K., if based on biological characters is very likely to assert itself in adult years; unless it becomes concealed beneath restrictions of environment and personality make-up.

### 4. EARLY ACCELERATION ASSOCIATED WITH DEFECTIVE NUTRITION (7 MONTHS TO 24 MONTHS)

The mental growth of K. L. is pictured in Growth Graph 6. This case will not be discussed in detail. It has much in common with the preceding; though the motor abilities are not so conspicuously developed. His early physical growth was retarded, and yet when he was brought to a pediatrist at the age of seven months, the latter remarked on his advanced behavior. At that age K. L. was rated by us as being between the eight and nine months level. An advanced or "superior" quality was detected in his emotional reactions, the persistence of his attention in test situations, and in his adaptiveness during spontaneous play. His whole aspect was mature even though he was underweight.

The question was raised whether the manifest strength of his drives was not a result of his nutritional needs, an intensification of the struggle for existence which permeated the whole behavior field. This speculation cannot be altogether ruled out, but its force is diminished by the fact that the drives have not declined with physical improvement. It will also be recalled that in the foregoing case, J. K., the same

strength of drives was noted and was found in association with excellent physical condition. It is more probable that there is a basic biological correlation between the acceleration of development and the intensification of



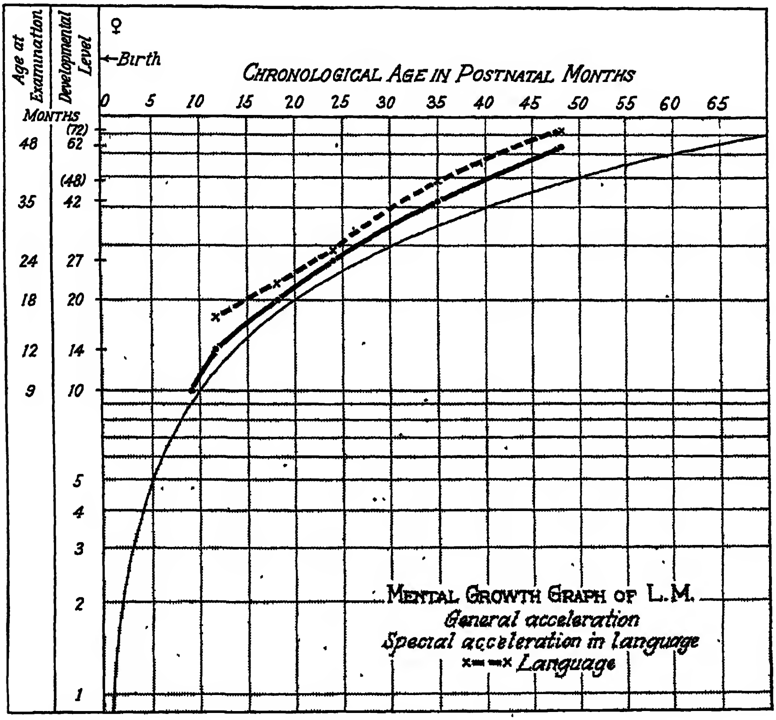

Growth Graph 6.

behavior. It is some energic increase which gives vividness to the whole behavior complex irrespective of ordinary body metabolism.

### 5. SUPERIORITY OF DYNAMIC CHARACTERISTICS IN INFANCY

The case of L. M., charted in Graph 7 was from the beginning rated as high average or superior. She was first seen when nine months of age and made a clear-cut success

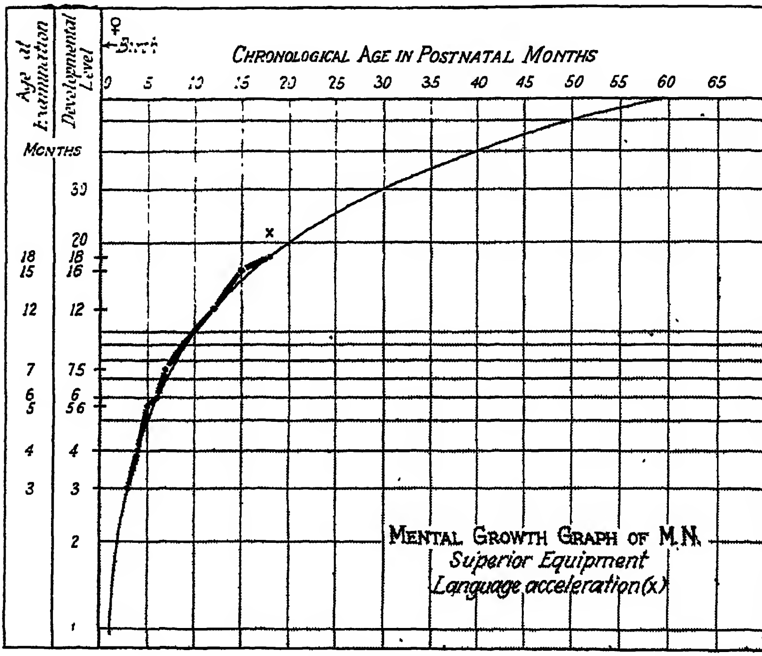
on the nine months schedule. She was characterized at the time as showing a high grade of attack and attention and as being very responsive and reactive. At twelve months, in spite of a dominating hand to mouth reaction, which interfered with the flow of her behavior, she made an excellent




Growth Graph 7.

showing on the developmental schedule. She made the same impression of eagerness and energy. She showed timidity but also control of it. Her assertiveness was accompanied by zealous vocalization. Her vocabulary at twelve months was eight words.

This early susceptibility to socio-verbal stimulation has not proved to be a transient phenomenon. It has been manifest during the course of four years of observed development, and is shown in the accelerated trend of the language line in her growth graph. Such susceptibility may well



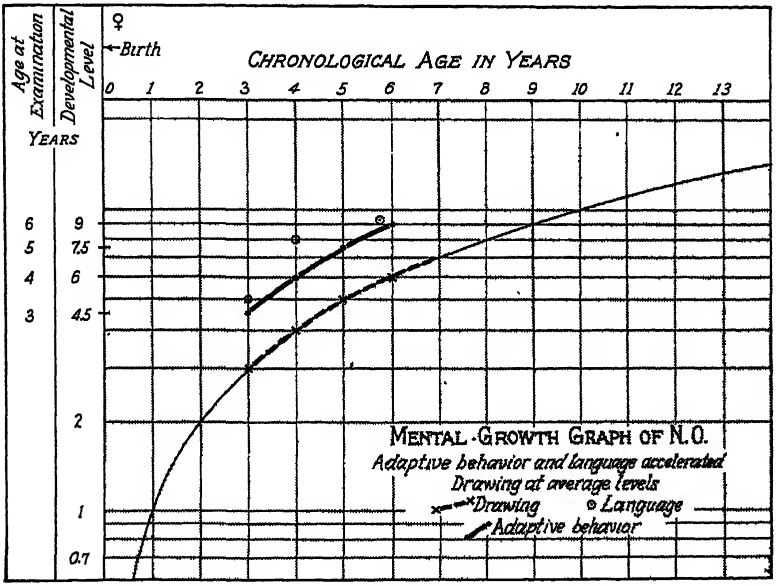

**Growth Graph 8.**

denote a general as well as specific growth potency. It tends to be associated with general superiority of equipment.

Again, in L. M., there is evidence of strong drive. The superior dynamic qualities are more evident than the developmental acceleration and probably more significant in early infancy than the developmental quotient. Indeed we have a few cases in our files in which the developmental

curve, plotted on the basis of performance alone, remains very close to the median course; but is associated with vivid dynamic characteristics. These may justify a clinical classification of "superiority," even though not supported by marked acceleration.

The case of M. N., Growth Graph 8, pictures a course of development which approximates a median but which has

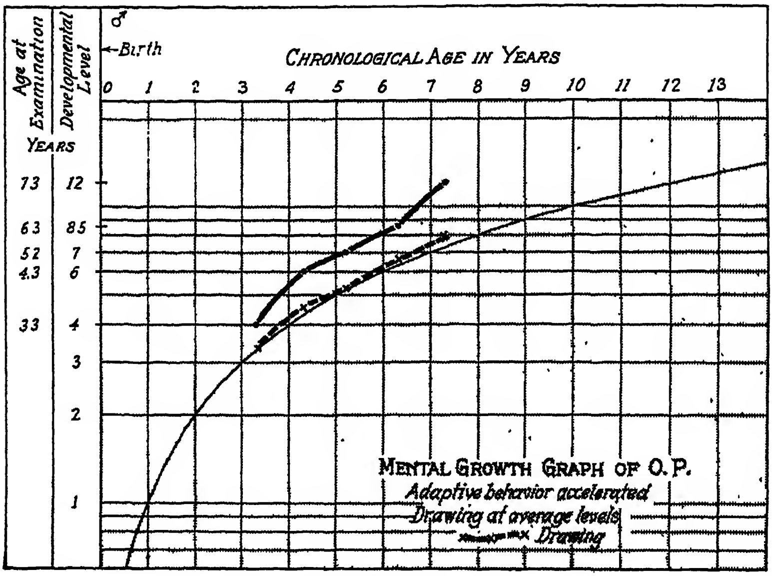



Growth Graph 9.

been combined with such excellent dynamic qualities as to suggest superior behavior equipment. It must be remembered that our lack of objective methods of measuring these "qualities" obscures the fact that they have a quantitative aspect just as truly as tempo. It is quite possible that in many individuals the rate of general motor development bides its own time, obeys the ordinary maturational tempo,

and does not share acceleration in other fields. If this is true we should have two distinguishable types of acceleration in infancy, one involving the gross motor equipment and the other not. And both might be correlated with superiority. The former type would present the more striking picture of precocity in early infancy.

A certain independence of the nonverbal, neuromuscular system in the developmental complex is suggested by the




Growth Graph 10.

two interesting children N. O. and O. P., charted in Graph 9 and Graph 10. N. O. at the age of three years was most appropriately booked on the four year schedule. Even at that tender age she showed a marked ability to utilize words and to deal with abstract situations. At the age of four years she dramatically defined enough words to gain an

eight year vocabulary rating. At the age of five years she gained eight year credit on comprehension questions and resolved one of the ten year absurdities and one of the twelve year similarities; but she was unable to bring the two lines of a triangle together in our drawing test. Her intelligence quotient has been 150, 150, and 145 in the three examinations.

O. P., who at the age of seven years earns an intelligence quotient of 163, showed the same curious inability to complete the converging lines of a triangle at the age of six years. His intelligence quotients at three, four, five, six, and seven years were respectively 117, 137, 140, 132, and 163. This psychometric fluctuation was quite out of proportion with our clinical estimates, which have consistently classified him as superior from the first examination. The superiority of the dynamic make-up of the child compelled such a classification in spite of the initially modest psychometric rating.

Both children were rated by means of the drawing tests in our schedules. These ratings showed a decided tendency to remain near the median line as shown by the graphs. Their performances in drawing were quite ordinary, but the autocriticism and conversation which accompanied the drawings were extraordinary. The difficulties shown in pointing the triangle and even in tracing the diamond, suggest a relative independence between the more primitive and the verbalistic motor systems. In Chapter XI (See Figure 54) the drawings of these children will be briefly considered.

The readiness of both children to deal with situations requiring abstraction and generalization was very marked at their tender age; and must be set down as a fundamental expression of acceleration in spite of the conservatism of motor abilities. We must not, however, imply that no errors were ever made: O. P., when asked, at the age of five, to

give the names of some islands, replied: "England, Princeton, France." At the age of six plus he was asked in a written exercise to answer a questionnaire. Two of his answers are too good to keep in oblivion: (1) "Of all the persons in the world, who would you most like to be?" Answer: "God." (2) "If you were this person; where would you like to go?" Answer: "To Yale College."

It is difficult to make summary generalizations on the subject of this chapter. That infants as well as adults differ in their behavior equipments, we have tried to demonstrate. How profound and far reaching these differences are when the economy of the total growth cycle is considered, is still beyond conclusive definition; but the evidence strongly suggests that the more basic differences in developmental dynamics project from infancy into senescence. Late growth does not come by way of mere supplement to early growth.

Generalization is hazardous because "superiority" is itself a very bare abstraction. It connotes intellectual ability, but it may also be applied to giftedness in personality constitution. Most basically it denotes an augmentation of the capacity to grow or to assimilate. Now it is this very capacity which is imaged in the growth characteristics of the infant. Acceleration may indeed be a major symptom of superior growth potency. To a partial extent, acceleration may bear the same genetic relation to excellence and superiority which retardation bears to inferiority and defectiveness.

There is evidence, however, that superior equipment is not always frankly manifested by quickened tempo. The symptoms then reside in the dynamic intensification and organization of behavior assets, which mature at an ordinary rate; and bear a superficial identity with those of common

humanity. In the absence of frank acceleration, it is this superficial similarity which serves to conceal actual and potential "superiority." Even such similarity vanishes when the total output of behavior for a day or week and the dynamic ordering and cohering of the infant's whole behavior picture are carefully studied. Then it becomes more clear that there are infants who may be described as superior in their own rights, as well as in their promise. A more acute sensitiveness to these subtle but significant symptoms can come only through the perfection of scientific method.

Human values need not be prejudiced in the quest of such method. The potencies of growth can be best conserved to the individual and to the race when they are recognized and understood. In a sense this is peculiarly true of all that pertains to giftedness and genius.

"Superior youth," "superior man," "superior boy," — these terms are freely and seriously used. The term "superior infant" has a flavor of strangeness and of humor. But this fact may simply be a commentary on the state of our knowledge and of our preconceptions.

# CHAPTER X

# ATYPICAL AND PSEUDO-ATYPICAL GROWTH COMPLEXES

## Irregular Deviations in Developmental Trend and Tempo

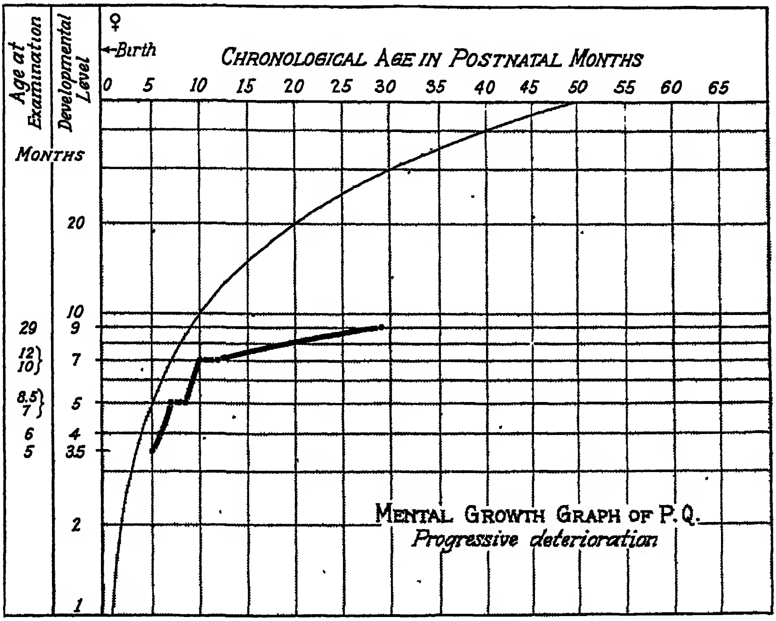
This chapter assembles several instances in which the early course of development presented unusual unevenness, or special difficulties in diagnosis. These cases, small in number, stand out as relatively exceptional because they contributed the wider ranges of deviation in developmental trend as reported in Chapter VII.

It is desirable to give some prominence to these departures from the ordinary, if for no other reason than to emphasize certain limitations and pitfalls in the field of developmental diagnosis. The importance of medical complications is made apparent. We may find among these atypical growth complexes exceptions which help to define and even to prove the rule. Special chapters are reserved for other unusual cases which are particularly instructive because of the critical light they cast on the mechanism of development.

Atypical growth cases naturally call into question the possibility of determining developmental outlook in the period of infancy. The general — and precautionary — principles which underly the clinical prediction of mental growth will therefore be considered in Chapter XVIII. In the present chapter each case will be individually summarized with brief comment.

### I. DYSTROPHY WITH PROGRESSIVE RETARDATION

This child, P. Q., was brought to a children's hospital at one month of age on account of extreme malnutrition, associated with cleft palate. The pediatric diagnosis was




Growth Graph 11.

dystrophy. She presented a picture of marked debility when first seen at the age of 5 months. Her mother was reported to be both psychotic and mentally deficient. The child's weight at five months was 3415 grammes; at her age she should have weighed about 5800 grammes.

In spite of this subnormal physical condition she made a modest showing on the 4 months developmental schedule.

Her outstanding performance was pronounced eye-hand inspection and head turning responsive to voice and bell. The dynamic quality of the behavior was reduced. She could not hold up her head. No developmental diagnosis was made; she was given a descriptive rating of approximately 4 months. Mental inferiority was more strongly suggested at this examination than mental deficiency.

On the second examination at the age of 7 months the clinical impression shifted to mental deficiency. An abnormal quality was noted in her hand play. She interlocked her hands tightly and fixated upon them for long periods. Her random and playful movements were limited in variety and scope. The behavior did not exceed the 5 months level.

In the next 2 months there was very slight gain and some loss in the behavior picture. At 9 months she reached for a spoon and a dangling ring; but there was no responsiveness to the sound of a bell rung near her ears. She could not yet hold her head erect. During this whole interval she showed an amazing preoccupation with her hands, to the exclusion of other forms of playful exploitation of environment. Her rating remained at the 5 months level.

By the age of 10 months this preoccupation had somewhat abated; but she continued to clasp her hands and suck them even when objects were presented. The rating was raised to the 7 months level chiefly on the ground that she occasionally reached for objects out of reach and manipulated them on a higher level higher than 6 months. The examiner also made allowance for the repressive and restrictive effects of hospitalization for the child had by this time lived in a hospital crib continuously for a period of 10 months.

At the age of 12 months there was no scorable gain in behavior. She banged a spoon on a table when stimulated.

If anything, she reached with less alacrity than previously. She regarded a pellet on the table, but did not try to attain it.

She has just been reëxamined. At the age of 30 months she presents a drastic picture of mental deficiency and rates developmentally near the 9 months level. Even this rating is liberal from the standpoint of the configuration of the total behavior picture. She makes progression movements when in the prone position. She sits alone and is beginning to stand alone. She can pull herself to the standing position. In these grosser motor items she rates near the 12 months level. She looks for a fallen spoon, lifts an inverted cup, seizes a string, and pulls in the ring placed flat on the table before her. She makes manipulatory responses to her mirror image.

These bits of ability do not appear in a natural context and are not associated with the attention ordinarily found in a nine months old infant. The items, however, represent the highest level to which her adaptive behavior fitfully rises. It is difficult to elicit her attention. From time to time she spreads her fingers and thrusts up her arm and fixes her regard upon the hand in a manner reminiscent of her behavior when she was seven months old. This behavior has an impulsive if not obtrusive quality, and bears no visible relation to the current stream of behavior.

It will be recalled that when she was an infant at the hospital at the age of 7 months, her preoccupation with her hands was the dominating feature in the behavior picture. The diagnosis of mental deficiency was made at the age of 7 months largely on account of the stereotyped restrictiveness of this eye-hand behavior. The wide range of deviation in the developmental ratings therefore results chiefly from the relatively high rating made at the age of 5 months, at which time she more closely simulated normality than at any sub-

sequent time in her history. Her abnormal physical condition was also weighted when this rating was made. Her present physical condition has much improved, as indicated by a weight of 11,019 grammes, but has brought with it no mental improvement. On the contrary, the retardation has, if anything, become progressive in severity.

She does not present a picture of symmetrical retardation. Is it possible that she is suffering from the effects of early, severe, and prolonged dystrophy? If she inherited a defective nervous system, the dystrophy may have been more disastrous for her than for a normal infant. It is noteworthy, however, that improved nutrition has not altered the growth trend. It is more probable that the behavior defects of this child at the age of five months were concealed beneath her physical debility, that her amentia is primary and inborn.

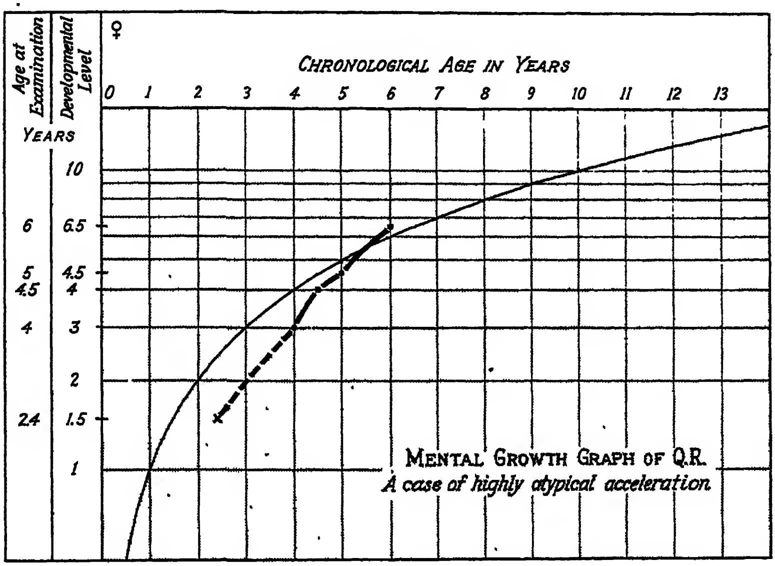
### 2. NEGLECT AND QUICKENED DEVELOPMENT

This child, Q. R., offers a strange converse of the preceding case; all the more striking because she is a sister of the foregoing P. Q. In the latter instance there was progressive retardation, while in the present there has been progressive developmental improvement.

When she was 28 months old, Q. R. entered a Babies' Emergency Home. She was then in a wretched condition from extreme neglect. We did not see her at the time, but the notes made in regard to her general development indicate serious retardation. She could scarcely walk, and said only a few words. When discharged eight months later, she was able to walk and to talk and to tell the story of "Peter Rabbit."

At the age of 42 months she was placed in a foster home. In the interval she had had scarlet fever and measles following an operation for mastoid.

At the age of 48 months she was examined by an assistant who had had specialized experience with children of that particular age. There can be no doubt that Q. R. fell very definitely below standard. Her general developmental level approximated three years. She was regarded as being of




**Growth Graph 12.**

normal but low average intelligence. She gave an impression of being very near a border-line level. Her drawing of the man at this age was a mere scrawl. Her reaction to the man-completion test was an uncritical scrawl. There was a general quality of inferiority in her responses.

At the time of the second examination she showed definite improvement. This improvement was particularly marked in language development. The emotional characteristics also improved, as shown by her adjustments to novel situa-

tions and by the disappearance of her timidity. Her reaction to the man-completion test had become adaptive in this interval of a half year. She supplied the missing eyes, ear, arm, and leg satisfactorily. It is significant that the developmental rating in a half year, therefore, could be raised to four years, which represents absolutely an increment of one year. Although block building and conception of form were well up to the age level, there was limitation in comprehension and number conception, which kept the clinical classification at the low average level.

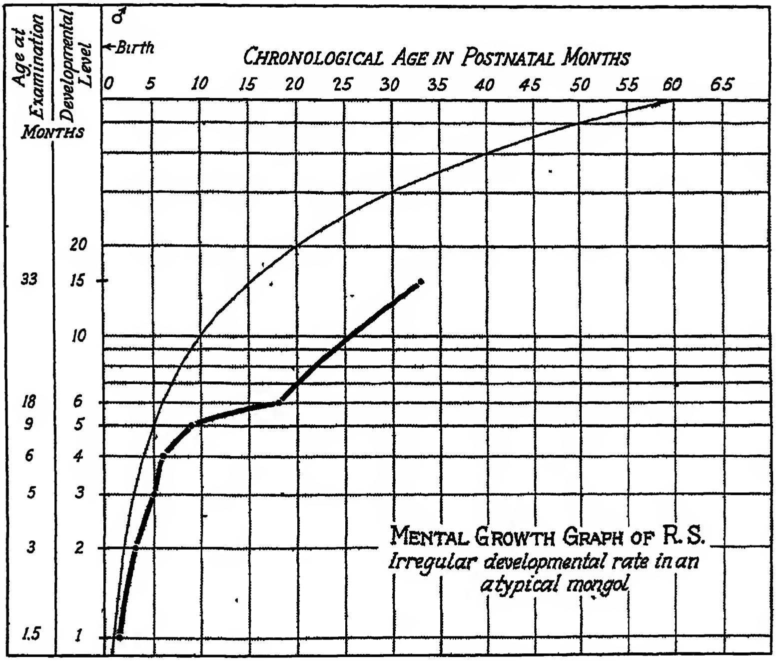
At the age of 5 years this improvement was maintained. She was rated at a 4 year plus level. With respect to motor control, she was definitely below the average. She could stand only momentarily on one foot in a manner similar to that of the average three year child. At the age of 70 months she was developmentally rated at a level of approximately six years, and credited with full average intelligence.

Taken as a whole this case shows constant developmental improvement, beginning apparently at the age of 28 months, so far as we can reconstruct the records. The clinical picture has changed in two years from one of near border-line mentality to full average and possibly high average intelligence. This, from the clinical point of view, is a significant degree of change, and very rarely encountered in our clinical experience. The mother of this child is mentally defective and suffers from recurring psychoses. Ordinarily this factor would have weighted the prognosis unfavorably when the early examinations were made. The early neglect was replaced by favorable environmental conditions including a foster home, a nursery school, and a kindergarten, with supervision of health and nutrition. In spite of the complication of scarlet fever, measles, and a major surgical operation, the improvement has continued consistently until

the present age of 6 years. Motor retardation and repressive environmental and personality factors may be considered in the interpretation of this growth history.

### 3. EARLY PSEUDO-NORMALITY IN MONGOLISM

This case is not truly atypical, but is briefly mentioned here because it illustrates several instances in which a




**Growth Graph 13.**

spuriously wide range of developmental deviation was tabulated for statistical treatment in Chapter VII. Clinically, mongolism was suspected in this child, R. S., on the first examination at the age of one month; but both at that

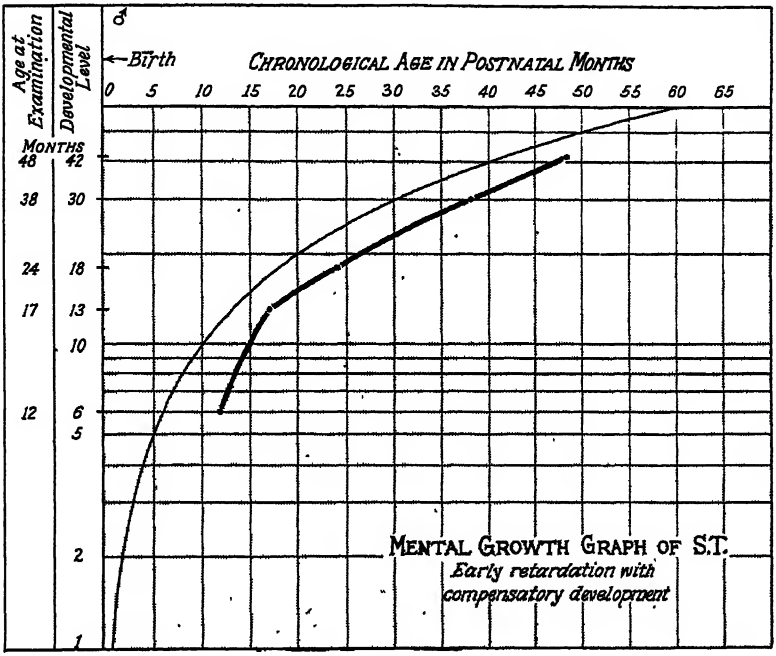
age and at 3 months, a relatively high descriptive rating was entered into the record to emphasize the superficial approximation to normal behavior. The significance of this approximation will be discussed in the section on "Mongolism" (Chapter XIII). Not only in the mongol but in other types of mental defect, there may be misleading semblance to normal behavior in the first two or three months of life. This fact is of theoretical as well as practical interest and will again receive attention in later chapters.

### 4. MOTOR RETARDATION WITH COMPENSATORY DEVELOPMENT

This boy, S. T., was examined five times in the interval between his first and fourth birthday. The developmental ratings as a series show a progressive relative acceleration, which calls for report and comment. On the first examination, the motor development of S. T. was if anything below the 6 months level. He needed firm support in the sitting position. He made no pushing reactions when his feet touched the floor. His maximum motor achievement was the securing of the pellet with a whole hand reaction, the fingers moving independently and not coördinating in the simultaneous flexion. The language development was apparently near the 6 months level. He gurgled and trilled and made other vocalizations. His adaptive behavior likewise seemed to be nearer the 6 months than the 9 months level. Persistent reaching for a remote cube and looking for a fallen spoon were his maximum performances. The whole picture was complicated by head rolling. In spite of this extreme retardation, the symptomatology did not definitely suggest mental deficiency, and the prognosis was carefully guarded but unfavorable.

In less than a 6 months interval the motor development progressed from an habitual dorsal position (he had been

content to lie on his back in his crib at the age of eight months) to walking with help. In the language field he progressed from vocalizations to articulating "mama" and "dada." In the adaptive behavior field he progressed from




Growth Graph 14.

the simple manipulation of objects to the insertion of a block in the performance box and to the building of a tower of three blocks. At 12 months he had acquired no nursery tricks. At 17 months he was waving bye-bye. This surprising improvement made the prognosis more favorable, although the clouds were by no means all removed.

This improvement has been maintained during succeeding

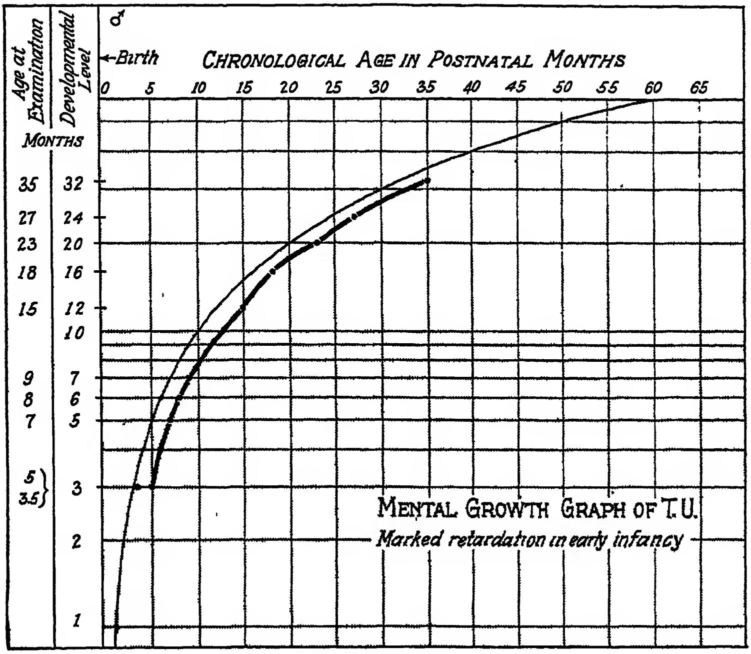
examinations. At the age of 4 years his intelligence is rated at a dull-normal level. But the total behavior picture is still not normal in its make-up. He cannot at the age of four years be recommended for adoption without qualifying inhibitions. His attention is still defective. He is over-active and his motor coördination is poor. The motor retardation of the initial examination therefore has projected itself through the ensuing three years, but not to the degree suggested on this first examination.

Whether this developmental history represents a definite instance of compensatory development and the gradual utilization of reserve neuromuscular equipment, it is impossible to say. This possibility is strongly suggested. The degree of improvement is exceptionally great. Occasionally there may be a surprising degree of motor retardation associated with normal intelligence. Only last week a boy aged eight years, of ordinary height (48 inches), but weighing 80 pounds, walked into the clinic. Although there was no neurological complication, his gait was infantile in character. He did not "learn" to walk until he was five years of age. His intelligence was fully normal.

### 5. TEMPORARY DEVELOPMENTAL ARREST IN EARLY INFANCY

The case of T. U. has proved to be developmentally so interesting that ten examinations have been made in the course of three years. This boy was first examined at the age of 3 months. He had been referred on account of marked nystagmus and smallness of fontanelles with precocious (though not completed) closure of the cranial sutures. In spite of these complications he made a good showing on the developmental schedules and was rated as being approximately at the 3 months level. The most marked subnormality was the defective head posture.

At the age of 5 months he was reëxamined; he made an almost identical showing on the same 28 items on which he had been examined 2 months previously. By ordinary scoring there was no gain in the interval, though there was




**Growth Graph 15.**

some increase in vigor and visual perception. The apparent lack of gain was so great that the following note was made in the record, "Child definitely begins to present a picture of mental deficiency." He was rated at the 3 months level, which suggests a developmental quotient of 60.

At the age of 6 months, the clinical record carried the following entry: "Performance would seem to indicate

some acceleration of development, as it now approximates that of a 4 months child. Reaching is at the 5 months level. Social responsiveness, conspicuously absent before, is now present. At this rate, will the child's development approximate that of a 6 months child at 8 months?"

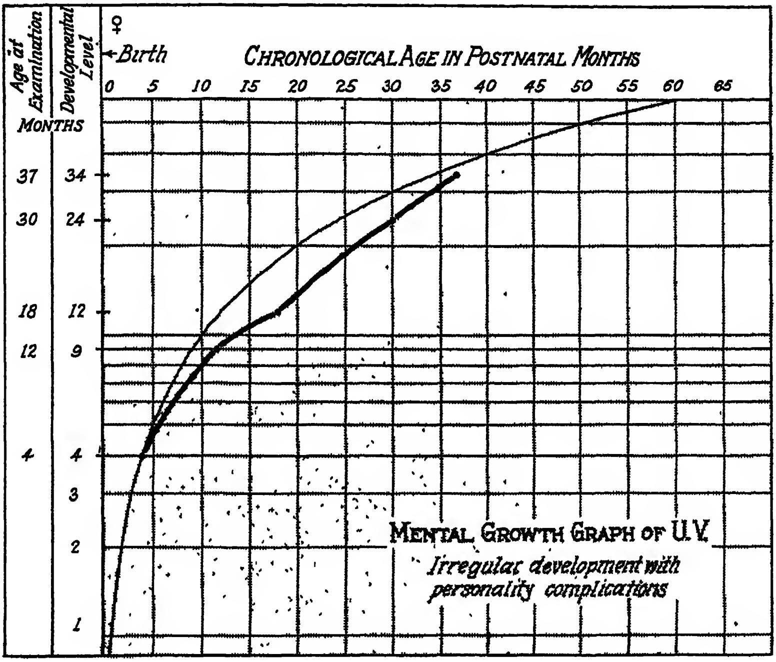
This question was answered in the affirmative. At the 8 months examination the child was rated at the 6 months level. At 9¼ months he rated at the 7 months level. At 15 months he rated at the 12 months level. Four more examinations were made at intervals, the last at the age of 3 years; and on all of these he presented a picture of either low average or of border-line mentality. A differential diagnosis between dull normal and border-line defective cannot yet be made with confidence.

The most atypical feature in this case is the relative arrestment of development between the ages of 3 months and 5 months. On the eight subsequent examinations this child showed consistent though retarded progress. It is possible that the disproportionate depression in the behavior manifestations at 5 months was in some way related to the unknown factors at the basis of the impaired vigor, the nystagmus, and the premature closure of the fontanelles. Although we have seen similar symptoms of accentuated retardation at an early age, they usually are part of a frank mental deficiency.

### 6. IRREGULAR DEVELOPMENT WITH PERSONALITY COMPLICATIONS

This child presents a definitely irregular developmental history, which is complicated by unfavorable home conditions and congenital syphilis. When first examined at the age of 4 months, U. V. rated developmentally very near her age. On the second examination, at the age of 12 months,

she made a rather poor showing on the 9 months schedule. At the age of 18 months she showed some gain in maturity, but could scarcely be rated on the 12 months level. Out of 28 items on the 12 months schedule there were 9 failures,




Growth Graph 16.

which is only three less than on the previous examination on the same items. The behavior picture on both of these examinations was characterized by an extraordinary degree of restraint and timidity. This expressed itself in recurring sobbing, and tentative, gingerly reactions to the test material. Initial response to much of the material was a negative withdrawal. She withdrew her hand from the paper,

cup, and cube, and could not be induced to play with the bell until the end of a forty minute session, when she lifted it up after a period of suspense and broke into a frightened cry.

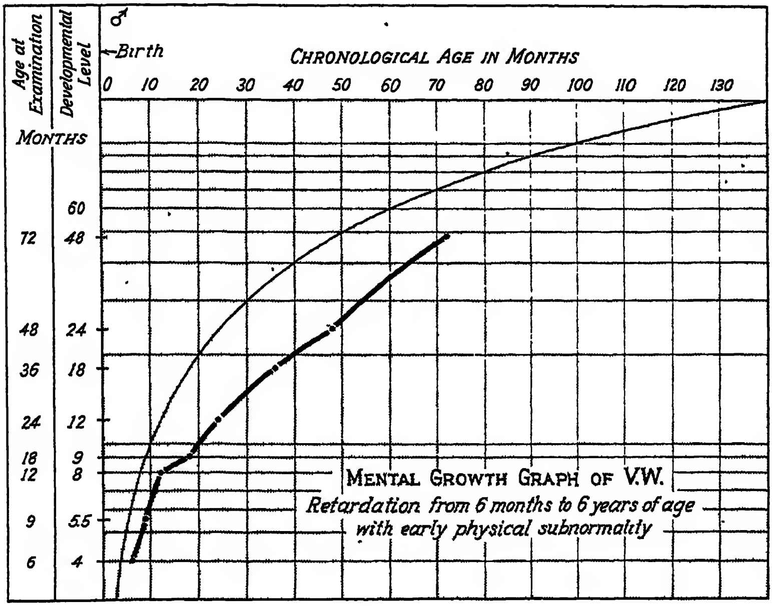
In some instances the material was vigorously pushed aside. This type of behavior is extremely rare in so young a child, and is the basis for our suspicion that strong personality factors influenced her developmental history. At the age of 30 months the excessive timidity and inhibition had largely disappeared, and she reacted more spontaneously and naturally to the whole examination situation. In the interval she had been placed in a good foster home where she received excellent care.

On the final examination the child was definitely friendly and spontaneous, and again approximated a level of behavior appropriate to her age. Clinically she may be described as being of low average intelligence. The irregularity of development is difficult to interpret. Although she was treated for syphilis from birth, it is possible that this condition has had an effect upon the developmental career. For a long time the treatment was very painful to the child, and this may have created personality conditions which masked her abilities. Whether the personality characteristics were derived from her experience, or whether they were the outcome of her physical make-up, they undoubtedly must be considered in construing this unusual developmental history.

### 7. SEVERE PHYSICAL HANDICAP WITH MODERATE DEVELOPMENTAL IRREGULARITY

This boy, V. W., was examined nine times in a period of six years. Viewed in its entirety the course of his development as recorded in an abundance of data is relatively consistent. The range of deviation is exaggerated by a disproportionately high rating made at the age of 12 months,

when the child was in an extremely poor physical condition, and undue allowance was made for his physical status. He was therefore rated as "near the 9 months level," and this accounts for a deviation of 15+points from the final classification index. Soon after his first birthday he suffered an




Growth Graph 17.

attack of pneumonia which kept him in a hospital for several months. At the age of 18 months his rating was decisively at the 9 months level. At 2 years he presented a very consistent picture of one-year behavior; and in spite of a well-constituted and attractive personality, there could no longer be doubt of his mental deficiency. Four annual examinations since then have shown a constancy in his developmental retardation.

The above comments are made to indicate that sometimes there is danger of overweighting the influence of even extreme physical handicap upon the course of mental growth. It may be added that since the age of 2 years V. W. has been well nourished and in vigorous physical condition, without any compensating effect upon the trend and tempo of his psychological development.

### 8. GENERAL COMMENT

A few general observations suggest themselves in regard to the foregoing group of atypical cases. In the whole group there are only a few instances which are thoroughly atypical and these can be construed only by a detailed individual analysis. They evidently represent unusual permutations in the growth complex. Inasmuch as these genuinely atypical cases are recruited from a wide and plentiful range of clinical sources, they emphasize the fact that development in general tends to cleave to type and pursue a relatively characteristic trend. The clinical significance of "atypical" cases should not, however, be underrated, for they are wholesome reminders that the general laws and the orientational norms of development must not be pressed too far in the interpretation of the deviating individual.

# CHAPTER XI

## DRAWING AS A DEVELOPMENTAL INDEX

### The Infant's Crayon and Paper Behavior in Relation to Age

Perhaps it would be preferable to substitute for "drawing" the term "crayon and paper behavior." For when an infant begins to draw in the sophisticated sense of the word is, significantly enough, a matter of some obscurity. The crayon itself, however, is a very frank recording instrument, and it is possible to secure the big size lumberman's crayon which is beyond the danger of being swallowed.

The gradation of responses which the infant makes with crayon and paper from the first month on through the whole pre-school period impressively confirms the essential orderliness of developmental sequences. Rarely have we found, in hundreds of drawing tests, that the infant does anything quite bizarre and eccentric with the crayon and paper. He tends very strongly to behave in accordance with the level of his psychomotor maturity; and to resemble all other infants who are at the same neuromuscular level. There are, of course, very interesting individual differences, but more impressive are the evidences of developmental determinateness which the individual records show. This determinateness seems to satisfy the inner mechanics of development more than it does either the conditioning influence of culture or the logical demands of our preconceptions. For example, "logically" an 18 months infant ought to make an imitative horizontal stroke just as easily and readily as a vertical one; but he does not do so.

By means of tabular synopsis we may bring the developmental advance of paper and crayon behavior into summary view. This synopsis and the accompanying chart will also give some perspective to the time intervals necessary for the maturation of the requisite neuromuscular coördinations.

I. THE GENETIC SEQUENCE OF CRAYON AND PAPER BEHAVIOR

0–1 mo. Reflex clasp of crayon without visual regard.

1–3 mos. Increasing complexity in manipulation reactions to crayon, without visual regard.

3–5 mos. Increasing visual coöperation in manipulation of crayon and paper. Clasps (with two hands) paper favorably presented. Picks up crayon on contact with hand.

6–9 mos. Reaches for crayon on sight. Brandishes, bangs, and crumples. Does not bring paper and crayon into exploitive relation. Hand to mouth reaction frequently dominates.

9–12 mos. Gradually brings crayon and paper into productive relation. Makes staccato banging marks; or faint wavering scrawl. Gives fugitive heed to demonstration of scribbling by examiner.

12–18 mos. Imitative scribble. Transient, fitful exploitation by crayon, with fugitive attention to marks produced. Increase of controlled innervation in bringing crayon to bear upon paper.

18–21 mos. More defined and spontaneous scribble. Makes a crude imitative stroke. Differentiates between a straight stroke and circular stroke.

24–30 mos. Imitates a vertical stroke. Shows prolongation of attention span in crayon activity.

30–36 mos. Makes two or more marks in imitation of a square cross, but does not make adaptive combination of strokes.

36–48 mos. Imitates a horizontal stroke. Brings vertical and horizontal strokes into relation in imitation of a cross. Copies a circle from a model.

48–60 mos. Copies a cross. Copies a square. Draws a recognizable man. Begins to differentiate between square and oblique cross drawn from model.

The foregoing table, although it serves its purpose as a conspectus, should not convey the impression that there is any abruptive staircase type of unfoldment. On the contrary, as the overlap in assigned age levels is intended to suggest, there is a gradual emergence from one stage to another. So gradual is this emergence that it will take a large amount of additional investigation to define the detailed differences in response, which will give infantile drawings more refined diagnostic value. Moreover, the technique of administering a drawing test, instead of being a very simple matter, is a very complicated one from the standpoint of exact standardization. It will take much study to determine the influence of both immediate and remote factors of conditioning and practise. But even in their present form, our schedule of drawing tests for the pre-school period has proved extremely useful clinically because of the objectivity and permanence of the record. The seriated drawings of an individual child frequently give a true outline of the trend and tempo of his development.

## 2. SUBNORMAL DRAWING DEVELOPMENT

This fact can be readily illustrated by the series of drawings assembled in Figure 49. These drawings are exact reproductions of the drawings of C. D., as taken from the clinical case record. On first inspection these drawings have an acceptable, normal aspect. They seem to advance with regularity through the usual genetic hierarchy. So they do; but they are stepped on a subnormal level, as a reading of the chronological age scale will show. They should be compared with the "norms" on the normative chart (Figure 48). If the temporal discrepancy between the two charts could be disregarded, the drawings of C. D. might be considered quite normal. But their signifìcence lies in the very fact that they

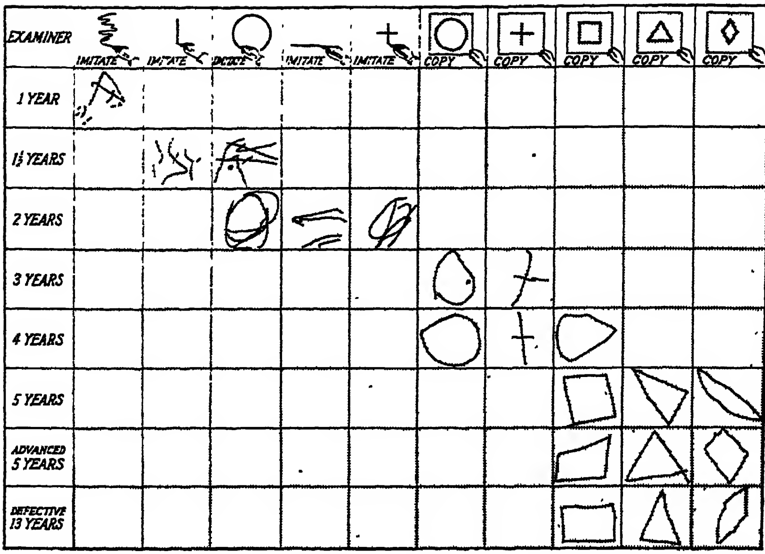



**Fig. 48. — Age chart showing typical progress in drawing.**

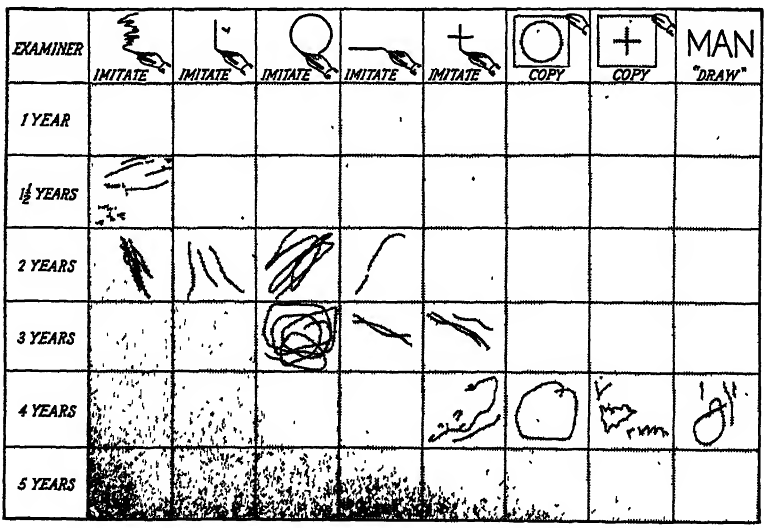



**Fig. 49. — Age chart showing subnormal progress in drawing.**

reveal a consistent retardation in psychomotor maturity, in association with an extremely imitative and amenable personality make-up.

At the age of 4 years, C. D. is scarcely functioning at the 3 year level in her drawings. She can differentiate between a

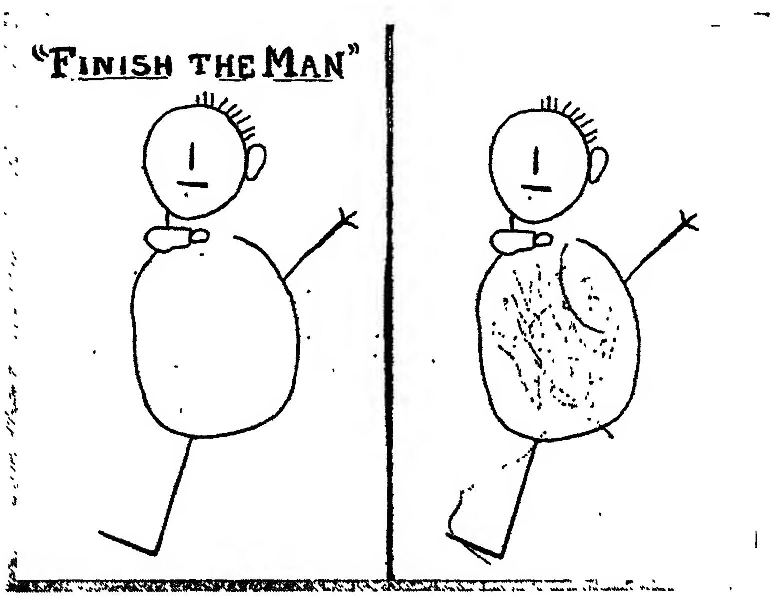



**Fig. 50. — Man completion drawing test showing the subnormal performance of C. D. at the age of four years.**

vertical and a horizontal stroke; but she cannot combine one stroke with the other to produce a cross. She makes a good 3 year circle, but draws a man entirely devoid of pictography. Her autocritical completion behavior is subnormal for her age in spite of the alacrity of her drawing and her social desire to please. This is convincingly shown in her response to the "man-completion" test. (Figure 50.)

The examiner presented the drawing of an incompleted man (shown in the left half of the plate) with the following instruction: "The person who made this man didn't draw all of him, don't you see? You finish him, make the part that is gone. Make a good man. He isn't all made yet!" C. D. responded with benign alacrity; but it is impossible to

**Fig. 51.—Typical spontaneous drawings of a man by a four year old girl and a five year old boy.**

construe her drawing as even a visceral completion. It is a typical subnormal "no-matter-whatism." It should be added that here again three year behavior is approximated, and that the typical four year child can make as many as three completions, supplying an eye, an arm, a leg, or other missing members and haberdashery.

When developmental retardation is symmetrical, drawing in the early years tends to be consonant with the general

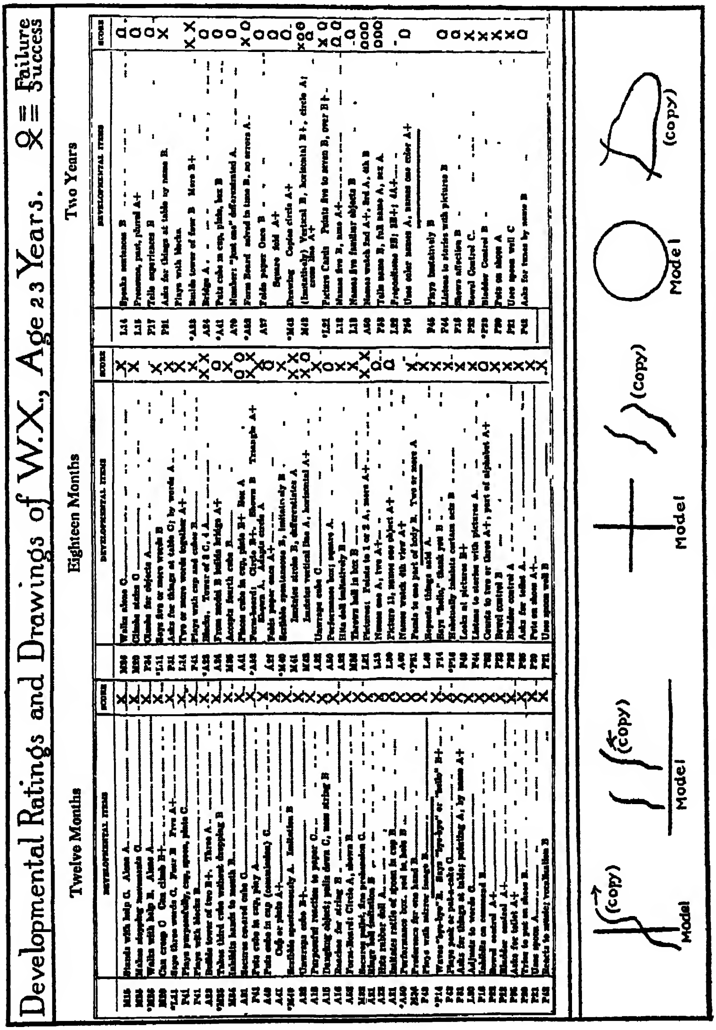



Fig. 52. — Adult retardation at an infantile level.

maturity level. This may be true even in extreme degrees of retardation. Figure 52 brings into comparative view the developmental ratings of a tall, physically well-developed, normal appearing girl, W. X., 23 years of age. In spite of her aspect of maturity it was necessary and feasible to record her behavior on the developmental schedules appropriate to infancy. Her passes and failures on 124 items are reproduced. She succeeded on all of the 44 items listed on the 12 months schedule. She failed on 26 out of 36 items listed on the 24 months schedule. Her ratio of success on the intermediate 18 months schedule was 35 to 9. Developmentally it is quite legitimate to classify her as mentally defective at an 18 months level. Her drawings, for one so old in years, are highly consistent with this characterization. She draws an imitative vertical stroke. She draws a responsive horizontal stroke, but it is actually a vertical one. Likewise she draws responsively two strokes in imitation of a cross, but they are not combined; they are simply given.

Such drawing behavior scarcely yields to an explanation in terms of habit or conditioning, even though the subject is adult in years. It strongly suggests that if we could glimpse the inner neuronic architecture of her nervous system, that we should find a patterning and a ripeness corresponding closely to the stage of development which a normal infant reaches at the age of one and a half years.

### 3. EARLY DRAWING OF SUPERIOR CHILDREN

It is an interesting and suggestive fact that the drawing tests reveal retardation in subnormal infants more commonly than they reveal a corresponding acceleration in superior infants. Growth Graph 9 and Growth Graph 10 show well-defined instances in which unquestionable general superiority was associated with ordinary drawing ability, so far as

technical performance is concerned. This discrepancy has been repeatedly encountered. It is somewhat offset by the manner in which the ordinary drawings are made; by symptoms of executiveness, intensity of attention, and imagination. Frequently there is copious dramatic or rationalizing comment as the crude drawings proceed. Sometimes there is an amusing soliloquy, which shows sense of humor as well as autocriticism.

The developmental conservatism of the neuromuscular apparatus in these cases of exceptionally superior intellectual endowment, suggests that marked mental ability rests not upon a generalized type of structural variation, but on specific and dynamic factors.

The occasional case of precocious manifestation of drawing talent points in the same direction. We have not been able to study such cases in detail; but one is cited because of its clear-cut documentation and hereditary background. The handiwork of Y. Z. (Figure 53) tells most of the story. The reader may spin his own theories of interpretation in examining these drawings, in the light of the norms which were recapitulated on page 216.

At the age of 3½ years this girl was drawing the human figure in varied attitudes and even in profile. One drawing shows a funny clown with "a small leg wrinkled like an umbrella." Another drawing shows the sun beating hot upon a wayfarer. A little later this same wayfarer is drawn in profile. This child has had no instruction in crayon; but she had a grandfather and a great-uncle both of whom were artists of ability. This is in accordance with Oliver Wendell Holmes' recipe in regard to the beginning point of education. It should be added that profile representations of the human face do not ordinarily appear before the age of 7 years. Y. Z. was only half that old when she drew her first spontaneous profile.

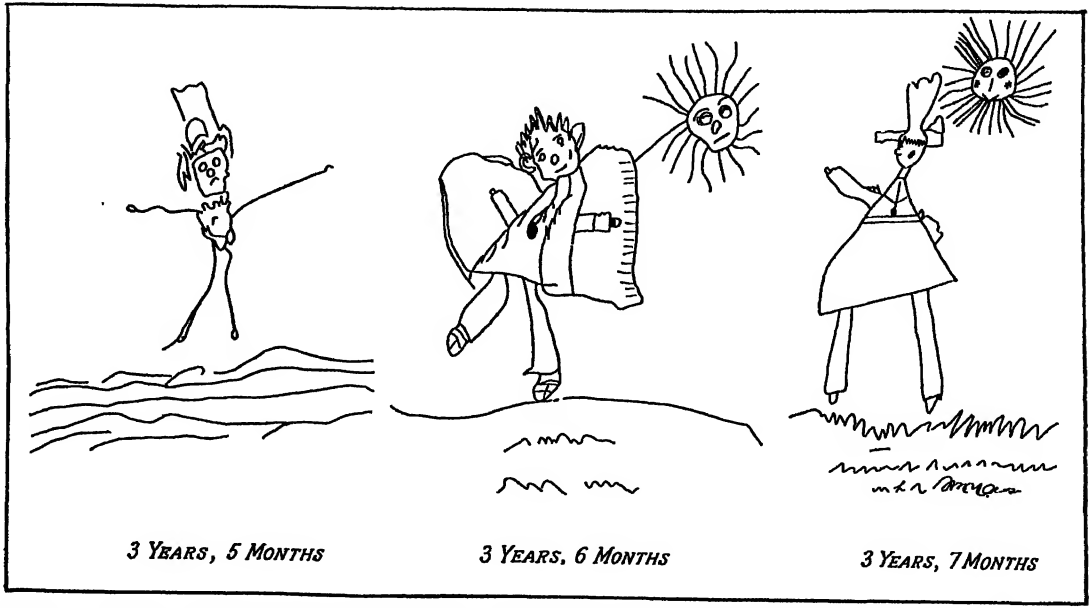



Fig. 53. — These drawings were made by Y. Z., a child whose grandfather and great-uncle both were artists.

The mother reports that she has given no instruction, but that the child at an early age was much devoted to working with crayon. The drawing of a man at 3 years and 5 months is already at the 5 year level. The similar drawings at 3 years and 6 months and at 3 years and 7 months show rapid increase in her abilities. Her first effort at drawing in profile occurred at the exceptionally early age of 3 years and 7 months. Ordinarily this ability does not appear until the primary school age.

These precocious drawings may be profitably compared with those of two intellectually superior children, previously mentioned as N. O. and O. P., who at the age of 5 years had intelligence quotients of 140 and 150. N. O., a girl, had a mental age of over 7 years; she had eight year credit on comprehension questions and on the Terman vocabulary test. The whole quality of her intellectual performance was on an unmistakably high level, and gives promise of genuine ability; but she was quite ordinary in her drawing performance. She could copy a square, but was literally nonplussed by the triangle, as Figure 54 shows. Her drawing of a man was no better than that of Y. Z. at 3½ years, but was relieved with sprightly comment: "I can't draw a man but I can draw a girl. This hair is too long, but I can take some scissors and cut around his head."

Likewise O. P., at the age of 5 years, earned a mental age rating of 7 years, and an 8 year rating on the vocabulary test. He also gives a definite picture of intellectual superiority. These two children showed striking similarity in the test items on which they failed and succeeded. Both were very ordinary in their drawing ability at the age of 5 years. The square again was simple for O. P.; but a struggle with the triangle is evident. His drawing of the man is quite mediocre.

It must be evident from this discussion that the beginnings of children's drawing yield to no simple formulation. The old view that scribbling is simply an incoördinated stage preceding representative drawing, does not do justice to the wide range of phenomena to be investigated from a genetic standpoint. The study of early drawing really involves wide areas in the fields of developmental neurology. Under experimental control, drawing behavior might almost be studied like neurological reflexes as indicators of the maturity

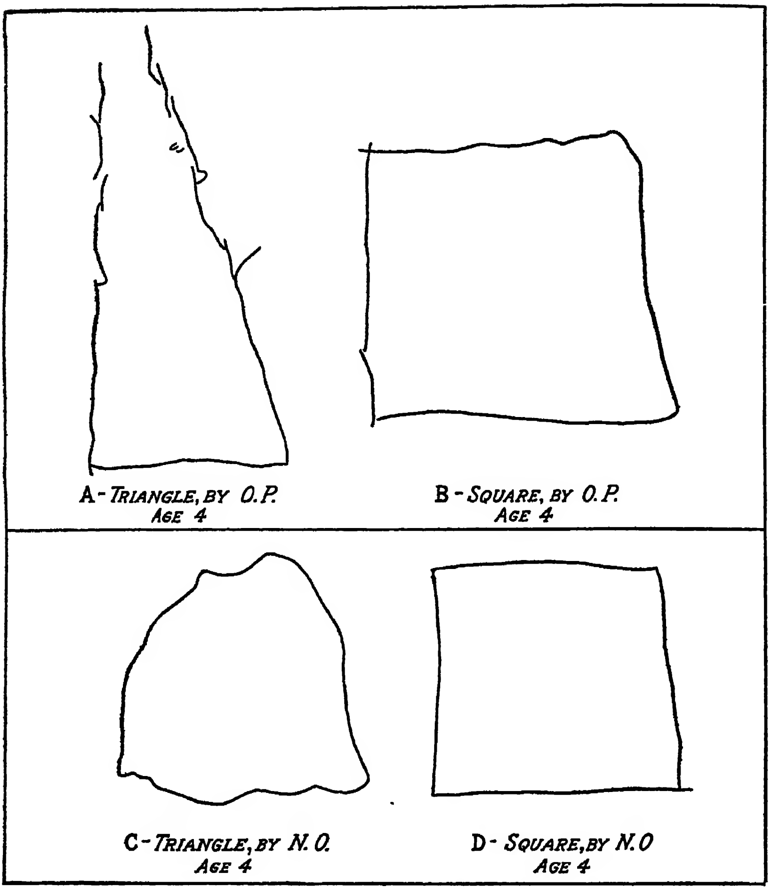



Fig 54. — These drawings were made by children of very superior intelligence. They show only moderate drawing ability.

Drawing A is the unsuccessful effort of the superior boy, C. P., to copy a triangle at the age of 4 years and 3 months. He was able to draw a square (B). In his struggle with the triangle he made twelve strokes, and remarked, "It seems to be going off the paper."

The drawings C and D are by N. O. at the age of 4 years. Drawing C is an unsuccessful effort to copy a triangle. She too was able to draw the square. Her general superiority and language acceleration are shown in her spontaneous autocriticism of her triangle. She said: "It's the same size (as the square) only it hasn't got corners."

and dynamic patterning of the nervous system. The neurological implications of crayon and paper behavior moreover come to light in certain cases of marked lefthandedness associated with mirror drawing.

As a genetic sequence, drawing represents an interdigitating series of patterns of response and a countless number of maturing stages. And where is the true zero of this plexus of abilities? Is it in the prehension of crayon, in the banging of the paper, in the imitative scribble gesture? The psychological differences in spontaneous, imitative, and induced drawing are of great interest in their nascent stages. Although drawing is no infallible measure of intelligence it gives insight into the process of psychomotor maturation. It thus becomes a significant index of the developmental status of the growing infant.

# CHAPTER XII

# THE TENDENCY TOWARD OPTIMUM IN GROWTH

## The Ascendancy of Mental Growth over Motor Disability from Birth Injury

It happens that the present chapter makes marked contrast with the immediately preceding one. We have just been emphasizing the significance of drawing as a form of motor expression, and as an index of developmental maturity. Now the discussion turns to a boy, A. C., who even at the age of 7 years is handicapped with such extreme motor disability that he cannot hold a crayon in his hands, nor bring it to bear upon paper. Nor can he sit up and reach for a crayon. He is almost entirely helpless, and mute.

In his psychology he presents noteworthy parallels and contrasts to the remarkable case of Helen Keller. In both instances life began with a normal or even superior promise. In both instances a damage to the growing brain blotted out vast areas of ordinary experience. In Helen Keller, the injury came through scarlet fever at the age of two years and deprived her completely of sight and hearing, and secondarily of speech. In this boy the injury came at the time of birth, damaged the normal blood supply to the basal ganglia of the brain, and deprived him, in extreme measure, of control of his voluntary muscles, including those of speech. Sight and hearing were unharmed. Helen Keller's handicap was completely sensory. His handicap is motor and partially sensory,

and lies in the field of kinesthesia—active touch— the very field in which Helen Keller has made her inspiring achievements.

The attainments of Helen Keller, through tactile-motor channels, have naturally been construed as confirming the importance of tactile-motor factors in mental development. James stressed the inherent motor-mindedness of human nature. Modern behaviorists place fundamental emphasis on motor reactions, on the receptor-effector arc, and on sensory-motor bonds. Mental life is conceived to be scarcely separable from motor responses. Such responses Helen Keller has enjoyed even on the verbal level, and through the eager moving of her sensitive hand she has been able to circumvent darkness and silence. The motor theories of mental life can readily enough account for the richness of her mental growth.

But what must happen to mental growth if the motor capacities which seem so essential are from the moment of birth diminished and obstructed? This has become a searching question in our work with the appealing young boy to whom this brief report is devoted.

## I. CHILD PERSONALITY SURMOUNTING HANDICAP

At the age of 5 (when we first saw him), A. C. presented a picture of infantile helplessness, even though physically he had attained full stature for his years, weighing thirty-seven pounds, and measuring forty inches. His features were well formed, his countenance normal and attractive. But his motor disability was profound. He could not hold up his head, he could not sit, stand, creep, or reach. Face, tongue, arms, and legs were moreover in almost constant involuntary activity. There was a succession of slow movements of flexion, extension, pronation, and supination of

fingers, hands, toes, and feet; and aimless thrusting of the arms. There was also recurrent spasticity. Even swallowing was accomplished with difficulty. The condition was one of extreme double athetosis.

Superficially, these symptoms might well suggest generalized mental deficiency. It gradually became apparent, however, that beneath and beyond these limitations there was a personality with normal strivings, and indubitable capabilities. This boy justifies no averse impression of defect. He has won for himself a circle of friends among children of his own age, who visit him and manage to play with him as though he were a playmate. He has won from discerning adults admiration for the valiant contest which he is waging against his handicap.

It is almost in the nature of an obligation to record the painful facts of this handicap in order to bring into evidence the latent and stimulated powers of mental growth which remain unimpaired. It would scarcely be defensible if we did not try to learn something about the hidden nature of the mind from such unbidden instruction. The truth can speak only if we do not turn from it.

Consider then the amazing degree of spiritual and intellectual survival which has surmounted the limitations of extreme motor disability in a child who has not enjoyed even the ordinary experience of early infancy in the acquisition of body control. His mental participation in the life of the world about him may be readily indicated by an incident which happened when he was five years old. Street repairs and dredging were in full progress in front of his house. He was propped up at the window where he might look on. The engine frequently blew a shrill whistle which was not agreeable to his sensitive ears. His mother asked him whether he wished to remain. He is able with great

effort to express Yes or No by crude head gestures which are so ungoverned that they much resemble each other, but which those devoted to him have learned to differentiate. By the same wavering token he is able to reply to questions which require a fairly high degree of discriminative judgment. . . . He chose to remain at the window.

On a similar occasion when construction work was going on, he saw the neighbors' children having great fun crawling through the big drain pipes lying by the side of the road. He became greatly interested. Though unable to articulate, he ejaculated "I-I" in no uncertain terms. This is his most vivid utterance and is used, whenever he is able to muster it, in all situations in which he wishes to call attention to his own stake in any event or plan. It was his unmistakable way of indicating that *he* wished to crawl through those pipes too. I am sure that he has enough "autocriticism" to know that he cannot crawl; but he also has enough imagination and drive to desire all possible experience, from sliding down a banister to riding horseback. With the aid of his sisters he was brought to the entrance of the pipe, and by their combined efforts and his struggling coöperation, he was propelled through the big drain pipe tunnel, to his great delight.

Although we might supply a volume of detail, this one incident must suffice to indicate why this boy has a well-defined interest in school work, and coöperates even in such "reading," "drawing," and "number work" lessons as we are able to devise. His personality sense is so robust that he wishes to have the same school-going status as his playmates. The preservation of the emotional growth of that complex of personality constitutes the most vital, although also the most difficult, problem in his whole management. Significant enough is it that in spite of his disability he has not lapsed into a state of acquiescent dependency.

## 2. AN UNUSUAL COMPLEX OF ABILITIES AND DISABILITIES

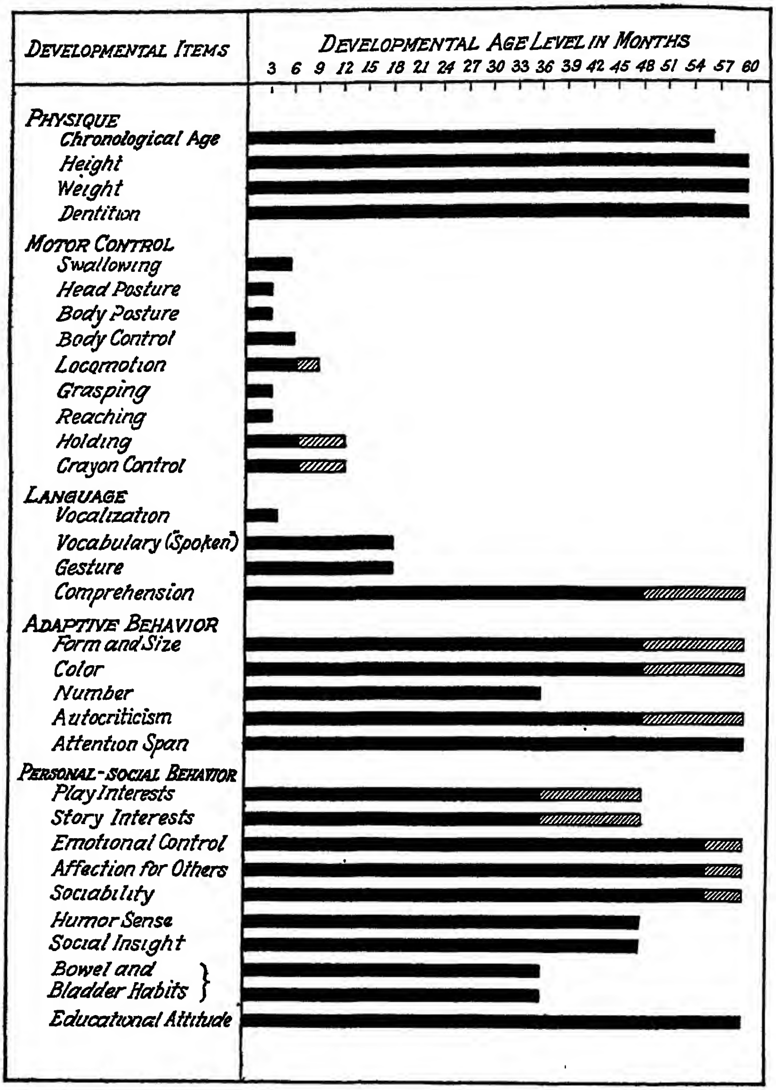
The accompanying psychograph and table give concrete indication of a most exceptional combination of abilities. The developmental status of A. C. at 5 years is expressed in age ratings on some thirty items, which permitted a rough normative estimate on the basis of objective evidence. Brief comments on selected items will furnish the data necessary for a discussion of the problem which most concerns us; namely, the influence of severe motor disability on the complex of early mental growth.

*Motor control:* This child had great difficulty in swallowing up to the age of about 4 years. Even at 5 years there was lack of synergistic regulation, and uncontrollable biting of the edge of the cup and spilling of the water. It could be descriptively stated that he did not swallow with the coordination of a six months old infant. This swallowing has somewhat improved in the last 2 years, but is not under ordinary control.

There was no sustained erect posture of the head at the age of 5 years. The head is subject to involuntary motions and remains transiently poised only at favorable moments. At the age of 7 years, the head posture is somewhat more steady, particularly when the child is held in a favorable sitting position. He is now able to lift the head occasionally in the prone position. Here again the rating from the standpoint of actual motor control must be in terms of extremely low age ratings.

At the age of 5 he could roll with difficulty from back to stomach and was able in the prone position to pull up the knees and make a kind of springing motion forward. But he could not maintain balance. This ability of course is

| Developmental Items | Descriptive Developmental Level | |
|---|---|---|
| **Physique** | | |
| 1. Chronological Age | 56 | months |
| 2. Height | 60 | " |
| 3. Weight | 60 | " |
| 4. Dentition | 60 | " |
| **Motor Control** | | |
| 5. Swallowing | 5 | " |
| 6. Head Posture | 3 | " |
| 7. Body Posture | 3 | " |
| 8. Body Control | 6 | " |
| 9. Locomotion | 9 | " |
| 10. Grasping | 3 | " |
| 11. Reaching | 3 | " |
| 12. Holding | 12 | " |
| 13. "Crayon Control" | 12 | " |
| **Language** | | |
| 14. Vocalization | 4 | " |
| 15. Vocabulary | 18 | " |
| 16. Gesture | 18 | " |
| 17. Comprehension | 48–60 | " |
| **Adaptive Behavior** | | |
| 18. Form and Size | 48–60 | " |
| 19. Color | 48–60 | " |
| 20. Number | 36 | " |
| 21. Autocriticism | 48–60 | " |
| 22. Attention Span | 60 | " |
| **Personal-Social Behavior** | | |
| 23. Bowel Control | 36 | " |
| 24. Bladder Control | 36 | " |
| 25. Emotional Control | 56–60 | " |
| 26. Affection | 56–60 | " |
| 27. Sociability | 56–60 | " |
| 28. Humor Sense | 48–60 | " |
| 29. Social Insight | 48–60 | " |
| 30. Play Interests | 36–48 | " |
| 31. Story Interest | 36–48 | " |
| 32. Educational Attitude | 60 | " |




PSYCHO-GRAPH OF A.C. AT THE AGE OF 4½ YEARS

**Growth Graph 18.**

less than that of a 9 months old infant who has begun to crawl about. Within the past year the child has been strapped into a specially constructed walker equipped with wheels. He is supported on a saddle and is able to propel himself by thrusting the feet against the floor. This control, although very fluctuating and imperfect, enables him to make considerable journeys on the open floor. It has had a very wholesome effect on his personality attitudes.

Prehension in the ordinary sense of the term did not exist at the age of 5 years, and has not been mastered at the age of 7 years. There is no voluntary control of the fingers, flexion and extension, and no ability to direct the hands definitely toward a goal. Objectively, therefore, this boy cannot at the age of 7 years, when lying on his back, close in on a dangling object with the precision and adaptive conclusion of a 4 months old infant. The reaching propensity, however, began to express itself as early as the age of 6 months, and this is a very important fact in the interpretation of the child's psychology.

It is difficult to assign any appropriate rating to the item of drawing ability. When a crayon is placed in the hand, under very favorable conditions, with the coöperation of the examiner, he is able to make scribblelike scrawls. In this restricted sense, the drawing rating could not be any higher than the 12 months age level. The interest in drawing results, however, extends far beyond this level. He took great delight in completing a simple drawing of a house with a chimney while we held and guided his forearm. There was vivid interest in supplying the stroke to represent the streaming chimney smoke.

From the standpoint of synergism and coördination, the general motor control must be rated at a low infantile level.

*Language:* The latter statement applies to speech, as a purely motor capacity. It can be truthfully said that he is barely able to pronounce a single articulate syllable, and the range of his vocalization is perhaps less than that of a 4 months old infant. In spite of this he has a definite interest in words, and even in their enunciation, and is able to make differential, though unintelligible, sounds appropriate to several words, like: "I," "you," "Hattie," "Brown," "bye-bye," "out," "do."

Reckoning these sounds as articulate words, his utilization vocabulary may be placed at an 18 months level. From the standpoint of comprehension, however, his vocabulary must be advanced to perhaps a 4 or 5 year old level. Detailed evidence cannot be given, but in numerous indirect ways it has been possible to infer that he has a comprehension of complicated sentences involving a relatively high degree of verbal judgment. This verbal judgment in the field of comprehension makes distinctions between "up" and "down," "long" and "short," "blue" and "red," etc. His crude gestures may be rated as being at least equivalent to 18 months maturity.

*Adaptive Behavior:* In spite of inability to explore the outlines of objects manually, it seems certain that this boy makes discriminating judgments with respect to form and length. His reaction to the blocks of the form-board were discriminative. He also made consistent distinctions between long and short lines. An incomplete figure of a hexagon was made with geometrical placques. He took great satisfaction in participating in the completion of this hexagonal figure by the insertion of one missing placque. Although this is a crude test, it suggests an ability in the significant field of form-completion, which is at a relatively high level. He showed the equivalent of color-matching

ability and seems to have preferences at the age of 7 for certain colors used in his paint box.

Comprehension of number has not been tested conclusively. He certainly makes distinction between one and many. At the age of 5 he was able to distinguish between two rings and three rings on the telephone. In the specially devised number lessons, he apparently participates in counting up to 10. It is probable from the observations made that at the age of 7 his number comprehension is at least near the ordinary 5 year level. It may be higher.

Extremely significant from the standpoint of clinical estimate of intelligence are the evidences of autocriticism which frequently come to light. His learning has not been of a mechanical, docile character, and he seems constantly to make a discriminative judgment between success and failure. Perhaps most significant of all is his broad attention span in the lesson situations. In spite of the exceptional methods used, the lesson period has considerable similarity to a comparable period in the school life of a normal child. This boy's attention can be held for periods which, if anything, are somewhat in advance of the average standard. The high rating of his intelligence on the psychograph is justified by innumerable minor points of observation which it would be impracticable to detail.

His attention span for the weekly reading lessons is now thirty minutes. This lesson is conducted with the boy in his attendant's lap or while he is in the walker. By crude pointing and nodding, and by propelling his wheeled car from one place in the room to another, he is able to identify words, pictures, and objects, and to interpret simple sentences or their key words. In this identification sense he has a recognition reading vocabulary of about thirty-five words. His general attitude and responsiveness in the lesson period

approach a primary school level. There has been visible growth again here in the last two years comparable to that which one finds in the progress of a child from the kindergarten to the primary school age.

*Personal-Social Behavior:* In the field of personal-social behavior there is considerable cumulative evidence that the boy has reached a level of maturity in the general organization of personality which is out of all proportion to his general motor control. He shows insight into relatively complicated social situations, he displays a high order of affection and friendship, and shows marked sociability of a discriminating kind. His social responses to children and adults are not of the uncritical character which one sees so often among mental defectives. His sense of humor also reveals a sensitiveness to incongruity and an appreciation for mistaken identity which denotes a relatively advanced intellectual perceptiveness.

He expresses his delight in humor situations with laughter which is well developed in its quality. He has shown consistent progress in his play and story interests. At the age of 3 he was fond of *Mother Goose*, and evidently comprehended the rhymes in some detail, because sad rhymes had to be revised into cheerful phrases before he accepted them with approval. At the age of 4 he showed interest in the story of the *Three Bears*. Now he is much interested in stories of horses. (He has a passion for horses and for Grimm's fairy tales.)

His emotional attitude in educational situations has already been mentioned. This attitude suggests a level of personality maturity quite appropriate to his years. His seriousness of purpose has been shown not only in the lesson period at the clinic but in the physiotherapy sessions at the hospital. Here he coöperates with a will in the exercises.

Frequently he assimilates a new instruction at the very first time it is given; and even though the exercises must be carried on to the point of pain he is eager to meet the regular appointments. Slight wonder that he has been able to bring his friends under the spell of his personality.

### 3. THE LIMITATIONS OF MOTOR THEORIES OF MENTAL LIFE

This boy, in spite of profound handicap, has achieved a degree of mental life which calls for interpretation. For such interpretation, ordinary psychological concepts seem somewhat inadequate, if indeed they are not brought into question.

In erecting our theoretical structures of the scheme of human behavior, it is barely possible that we have given too much weight to the motor building stones in the structure. This boy has had motor experience, but the experience has been blurred; the reactions have been extremely faulty and unpatterned. In spite of this poverty and distortion of tactile-motor data, his "mind," or his personality, has undergone a high degree of ordered development. It is this astounding disparity between motor performance and mental maturity which challenges interpretation.

A 4 months babe on his back can apprehend a dangling ring and seize it by a closing-in response. A 6 months babe can sit upright and with head poised can detect a dangling object and reach for it directly on visual cue. Having seized it he can manipulate it and tactually explore it. Later the baby will name the object, and the laryngeal verbalization weaves itself into his mental equipment.

What is the inner mental equipment of a boy who by the age of 7 has been denied these fundamental experiences? What takes the place of the ordered data of touch and motion which even the blind and the deaf must acquire to live mentally?

We have been told by an intelligent young man who himself had suffered from athetosis in childhood that he is still handicapped by the erroneous kinesthetic sensations which had their origin in his early years. He humorously refers to his "strychninized frog" movements. The faulty motion formulae of his childhood obtrude themselves in an obsessive manner while he is mastering simple motor coördinations in his mature years. This introspective and retrospective testimony suggests that the motor disabilities are not only negatively handicapping, but work with a positively disturbing effect.

If the development of an infant suffering from severe double athetosis had to wait for the clarification and definition of motor experience, his mental growth would be very much retarded. It seems, however, that the onward movement and elaboration of the growth career does not have to wait for the accumulation of ordinary motor experience. The maturation of motor propensities is not completely dependent upon actual experience. It is for this reason that the propensity to reach and to handle asserted itself in this handicapped boy at the normal age of six months, despite the fact that his motor impulses were denied the stimulus of accomplishment. Even at this early age the child showed definite signs of annoyance because of his inability to attain and hold his toys.

At the age of five years, social suggestion, as we have seen, operates so forcibly that he desires motor experience which is altogether beyond his powers. If the injury to the brain had been of wider scope and involved the cortical areas, the resultant behavior picture would have been quite different. It is because the lesion has been restricted to the synergistic and coördinative mechanisms that such a high degree of development has been realized.

It is probable that the kinesthetic data furnished by the oculomotor muscles have furnished some scaffolding for this boy's mental equipment. He definitely fixates visually upon objects and he deploys his eyes to apprehend them, even though he cannot grasp them with his hand. The inability to maintain head posture and a partial defect in the oculomotor control itself, operate to diminish even the oculomotor data. However these data may well play an important rôle both in imagery and perception, and contribute some of the substantive elements which in Helen Keller come through active touch.

The larynx and speech apparatus have provided but meager and faulty content to the mental structure. The motor aspect of verbalization in this boy must therefore be very scanty indeed; and yet his mental life is highly verbalized, so far as we can infer. Ordering and organization have apparently been wrought out of mere fragments. Pattern is woven even when fabric is thin and broken. If it were not so the behavior picture would be comparable to amentia or dementia. It is not comparable to either.

The degree of patterned growth which takes place after a vascular injury to the brain at birth is not mainly determined by the motor disability itself; but by innate endowment, by the areas of the cerebral cortex unharmed, and by the opportunities for the compensatory development of neuroblasts and neurones. The first and last of these factors may well have some interdependence; so that a potentially superior nervous system will be less affected by a lesion than one of lesser grade. For all these reasons natal brain injury may result in varying degrees of intellectual and motor impairment. There may be extreme and extensive paralysis without mental deficiency. There may be slight paralysis with extreme mental deficiency. The momentum and

limits of mental growth are apparently determined more by the psychic and symbolic systems than the sensori-motor, whether cortical or subcortical.

This suggests that the tactile-motor elements in the organic behavior complex are not as crucial as is frequently supposed. They figure heavily in all normal mental development; they figure even in the case before us; but the point to be emphasized is the vitality and fullness of the mental life which has been attained in spite of the paucity, the incompleteness, and actual blemish of kinesthetic experience. This fact argues that there are limitations to the explanation of behavior in motor terms. It argues also the value of dynamic concepts such as those of configuration or Gestalt.

### 4. THE TREND TOWARD OPTIMAL GROWTH CONFIGURATION

*Mental growth tends toward an optimum realization.* If the sources of energy on which growth depends are not stopped, as they completely are in profound idiocy, then there remains a measure of specific and general potency. This potency expresses itself in the progressive maturation of modalities and dispositions of behavior, even when normal patterns of behavior cannot be consummated. Herein lies the urgency, the almost irrepressible quality, of growth. Herein lies a life tendency which works toward adjustment, harmony, and completion even in the gravely handicapped child. Accordingly there is an optimum utilization of impaired instrumentalities and impaired impressions. This tendency toward optimum development is in the individual comparable to the recognized, though poorly understood, evolutionary trend of the racial stream of life.

The inherent physiological growth potency, however, is not all. Helen Keller confesses in her autobiography that she might have been stranded in a state of relative mental

savagery if in her early childhood she had not caught the transfiguring social concept of the *word*. At a dramatic moment which she still remembers, she made the liberating association between water and the tactile word *water*, which her teacher was spelling in her palm. This event proved to be the germ of Helen Keller's extraordinary intellectual growth. This growth has been sustained and conditioned by the socializing influences of her friends, family, and skillful teacher. These influences directed and almost constituted the impetus toward progressive development. In the case of our handicapped boy, likewise, the devoted, intelligent care of his family has been the medium and mould for his development. Without their untiring sympathy and courageous stimulation, he could not have attained his present mental stature, nor shared as fully as he does the common life. Social suggestion, indeed, has operated so strongly that he imitatively desires motor experience which is far beyond his capability.

The considerable triumph of patterned growth despite so drastic interference with the ordinary conditions of growth, is a fact of searching implication both for theory and for practice. We can wrest from such unfortunate embodiments of disadvantage a confirmation of the constructive and conquering tendency of growth. The whole reaction system of the individual tends to be ordered and organic even though its resources are imperfect. The mental structure is not in unalterable proportion dependent upon tactile-motor function. If in a naïve architectonic sense the organization of mental life depended predominately upon motor reactions, it would be impossible for an infant with profound motor disability to attain the degree of development which we have described. On the contrary the behavior picture would have been a disjointed caricature.

All this does not, of course, oblige us in any way to ignore or depreciate the importance of tactile-motor factors in the normal and ordinary economy of mental development. Nor does it cast doubt on the very great importance of physiotherapy and muscle training, particularly in those instances of birth injury which have left unimpaired the hidden sources of mental life. It appears, however, that the organization of the striped musculature is not as extremely essential to the attainment of mental maturity as has been suggested by overmechanical theories of human behavior.

We have glimpsed the mental life of a boy who from birth was thwarted from motor control of his physique and of his environment. That life suggests a developmental physiology which goes far beyond the atomism of simple sensori-motor formulae. It is possible by means of such formulae to assemble a psychological mosaic which bears some semblance to human nature; but it is the semblance of marquetry, and not a true portrait.

# CHAPTER XIII

# GLANDULAR AND NUTRITIONAL FACTORS IN MENTAL GROWTH

## Psycho-developmental Aspects of Mongolism, Puberty Praecox, Thyroid Deficiency, and Rickets

The present chapter assembles a few brief studies from varied sources to inquire into the relationship between unusual physical and mental conditions. In some instances the developmental interrelations are immediate and unmistakable. In other instances they are difficult to demonstrate.

### 1. PHYSICAL CHARACTERISTICS OF MONGOLISM

Mongolism is a variety of amentia so named by a British physician because in facial features it bears certain resemblances to the Mongol, Kalmuc, or Tartar physiognomy. The chief resemblance is in the obliquity of the eyes. The term should be taken in a purely descriptive sense and not as an anthropological concept, although another British writer has recently advanced the daring suggestion that the mongol in our caucasian midst represents the persistence of an ancient racial stock.

Suffice it to say that clinical mongolism appears among many peoples; more frequently in some countries than others, and that mongol children as a group, indeed, resemble each other so closely that they look like members of the same family. The cause of mongolism is unknown, but Dr.

Sutherland concludes from this family resemblance that some one cause is operative in all cases to produce such a definitive type.

It seems justifiable to regard mongolism as a developmental anomaly rather than a specific hereditary entity. Two mongols scarcely ever appear in the same family, and in many instances the family is notably free of mental defect. But even assuming some germinal neuropathic background it is possible that peculiar glandular or nutritional defects in the uterine period produce the characteristic combination of physical and mental traits. Few if any varieties of amentia are so consistently similar as mongols and this has given rise to the belief that mongolism is the result of some common endocrine fault. Dr. Timme has advanced both pathological and therapeutic evidence to show that the pituitary gland is involved. There is, however, no agreement as to the specific etiology of this developmental defect.

The physical characteristics of the mongol which are fairly constant pertain to the skull, face, eyes, skin, and hands. The skull is rounded, small, and short in the antero-posterior dimension, without recession of the frontal region. The face is somewhat flattened; the lips full and often fissured; the tongue transversely fissured and marked by large papillae. The eye slits are narrow and almond shaped, sloping downward and inward. The nose is squat and short. The skin is rough and tends to be flushed and downy in the region of the cheeks. The hands are broad, flabby, and look clumsy even though the fingers taper. Tredgold has noted a deviation of the hand to the ulnar side and an unusually large cleft between the big toe and the next. The joints are lax.

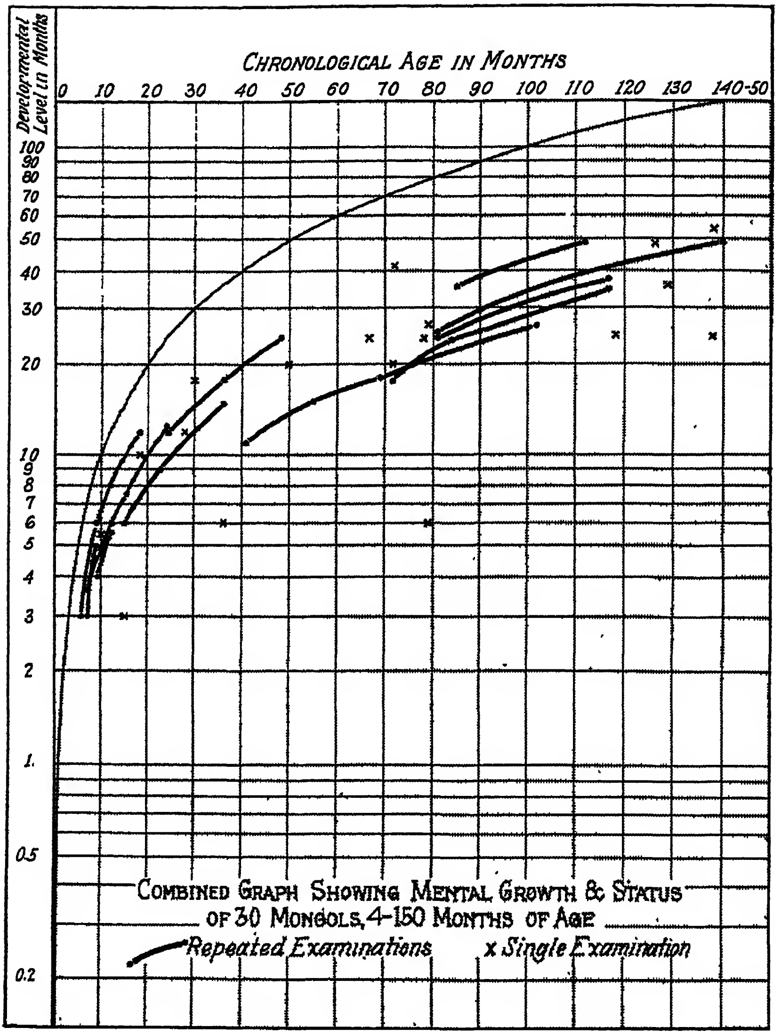
Other associated peculiarities of anatomical nature could be detailed. Those mentioned are sufficient to suggest

that mongolism is due to some curtailment or impediment of the growth process, which occurs under such similar conditions as to produce a distinctive type or symptom complex. The suggestion that the mongolian is an "unfinished" child is not altogether amiss. Whatever the causative factors they date back into the foetal period. Frequently mongolism can be diagnosed immediately after birth by the physical signs alone. It can also be predicted that such a child will be highly subject to chronic nasal catarrh, bronchitis, and inflammations of the respiratory and alimentary tract, and that he will have less than ordinary resistance against illness in childhood or youth.

## 2. THE MENTAL GROWTH OF THE MONGOL

Now it is a fact of great interest that the behavior symptom complex of mongolism also adheres very steadfastly to a distinctive type. The later mental characteristics of a mongolian infant can be predicted in outline and measurably even in detail. The fact that mongolism psychologically runs so true to type again suggests that the condition arises from some peculiar defect in the early physiology of development.

The accompanying chart (Graph 19) summarizes the results of diagnostic and periodic developmental examinations of thirty-eight mongolians, from 6 weeks to 14 years of age. The group may be regarded as unselected. There were twenty-four boys and fourteen girls. The total number of examinations plotted on the graph is seventy. It will be seen that the amount of variation in the mental growth of mongolians is comparatively narrow. The great majority of the cases are confined within a sector bounded by developmental quotients of twenty-five and fifty. There are a few scattered cases rating somewhat higher and still more rating somewhat lower. There is also a tendency, to be




Growth Graph 19.

commented on later, for the older children to rate somewhat lower than the younger. The mongolian child rarely rises above the kindergarten level of ability and often is slightly below that level.

Mongols taken as a group show somewhat greater constancy of developmental tempo than do unselected mental defectives. This is to be expected if mongolism is a well defined clinical type, with a common etiology. The developmental ratings of ten of our cases of mongolism were paired with ten unselected cases of retardation, similar with respect to developmental index at the time of the first examination, age, and number of examinations. The average amount of percentile deviation was computed for each member of the pair. When these averages were added they summed to 46 for the mongols, and 85 for the comparative group, which tends to confirm our impression that the former pursue a more uniform course of development.

| Paired Cases | Average Range of Deviation | |
|---|---|---|
| | Mongolians | Defectives |
| 1 | 0 | 4 |
| 2 | 1 | 8 |
| 3 | 2 | 6 |
| 4 | 3 | 2 |
| 5 | 4 | 10 |
| 6 | 3 | 8 |
| 7 | 5 | 23 |
| 8 | 5 | 7 |
| 9 | 9 | 7 |
| 10 | 14.2 | 10 |
| | 46 | 85 |

One of the children, F. H., who rated highest among the group of thirty-eight requires special mention. At the age

of 8 years her intelligence was at a 5 year level, and was sufficient to permit her to acquire a fair degree of facility in reading. She could write her name, draw a man, and copy a square. This is well above the level of attainment and ability of an ordinary 8 year mongolian. Why should she do so well? Not surely because she was given thyroid at the age of 3 months and fed on thyroid for a period of 3 years; nor because she has a docile, good-natured temperament, for that is characteristic of most mongols. It is more probable that she represents a milder degree of mongolism. Indeed she approaches the semi-mongol or mongoloid type in her physical constitution. The shape of her skull is characteristic, but her eye slits are not oblique; her tongue is long and tapering, with enlarged papillae, but without fissures; her fifth digit is in-curved, but her joints are only moderately lax. Her height, 47½ inches, is not extremely subnormal. In other words the physical stigmata are not as well defined as in typical mongolism. It may well be, then, that the original cause did not operate with ordinary severity, or came at a stage of development somewhat later than usual.

One of the children, who had the lowest grade of mentality shown on the chart had a 2 year rating at the age of 13. He could not copy a cross or a circle. He had a sister and two brothers who had been committed to an institute for mental defectives. It is possible that the mongolism was superimposed on an originally inferior endowment. Although mongolism usually occurs in families without discoverable defect in the ancestry, it cannot of itself be taken as "a certificate of good blood." This kind of family history strengthens the view that the etiological factor in the production of mongolism is epigenetic, if not glandular.

### 3. BEHAVIOR CHARACTERISTICS OF THE MONGOL IN EARLY INFANCY

The early diagnosis of mongolism presents a problem of some difficulty. Frequently the physical signs are well enough defined so that they can be recognized in the newborn babe. On the other hand the physical characteristics of the normal, newborn babe may sometimes take on an altogether erroneous suggestion of mongolism. In cases of doubt a careful study of the behavior characteristics will aid in determining the differential diagnosis. But even in the behavior picture there are misleading elements.

These deserve brief discussion on account of their developmental interest. Graph 13 plots the curve of mental growth of R. S., a boy in whom mongolism was suspected at the age of 6 weeks. In the dorsal position he displayed moderately active movements of hands and arms; his head was slightly lifted in the prone position; he made postural reactions to handling; he swallowed with fair vigor; he made seeking movements when the nipple was withdrawn; his eyes regarded a saucer held before him. In other words he made a fair approximation to normal behavior in several directions. At the age of 3 months he was reëxamined. Again he made approximations to normal behavior — in his vocalizations, in adaptive motor response to being lifted, in playful inspection of his own hands. The last item in particular, coming into evidence at the age of 3 months, might well seem inconsistent with mental deficiency; but at the age of 5 months the diagnosis of mongolism was beyond any possible doubt. At the latter age he was rated near the 3 months level. At 6 months he was at the 4 months level. At 9 months he was at the 5 months level. This rating was raised to only 6 months at the age of 18 months.

The final examination at the age of 33 months placed him at the 15 months level. Even at the age of 6 weeks the behavior picture was most comparable to that of a 4 weeks child. This discrepancy of a half month, difficult to score, but present in the picture, was of diagnostic and prognostic importance in spite of the subnormal weight and nutrition.

The irregularity of the ratings in this case, although somewhat unusual for mongolians, does not call for interpretation so much as the pseudo-approximation to normality in the early months. It was only a pseudo-approximation, because the reactions themselves were greatly reduced in vigor and vividness. The crying, feeding, and vocalization were weak. Such postural control, particularly of the head, as was present was intermittent and poorly sustained. The whole picture showed dynamic reduction even though many items could be individually credited on the developmental schedule. The moral of all this would seem to be that with mongols such dynamic subnormality must be weighted as a positive diagnostic sign, and not an incident to be discounted. The presence of such a complicated bit of behavior as the infant's visual fixation on his own hand suggests that this reaction is largely subcortical at this early stage of development; and this must then be discounted if the other evidences relating to intensity, tonicity, and integration point toward defect.

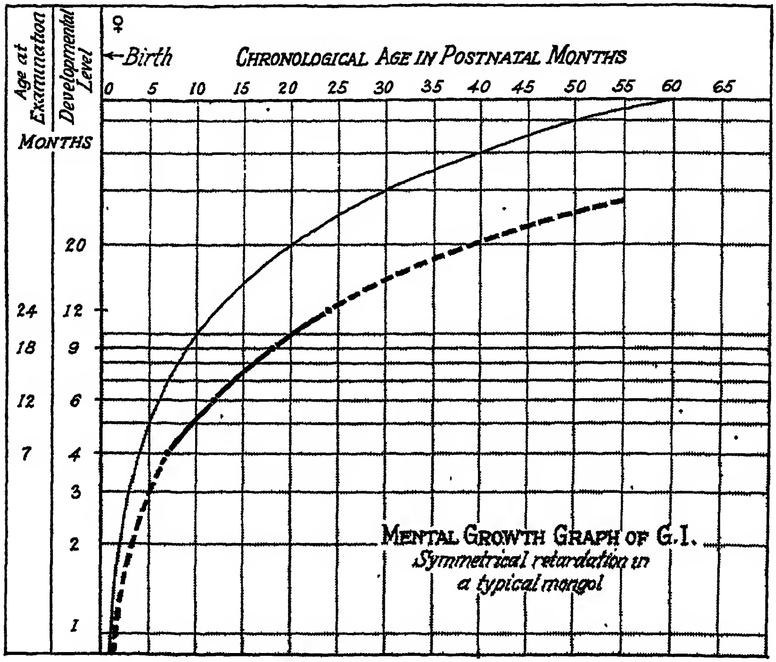
In another mongol infant, age only 12 weeks, there was marked selective regard for the mother's face. This reaction stood out like a prominent island in the map of his behavior. Viewed by itself it suggested normal adaptive behavior; viewed in the whole context it lost its importance as an item of normality.

When the superficially plausible behavior capacities of the young mongolian infant are brought into diagnostic

comparison with those of a truly normal infant of the same age of the same developmental level the importance of dynamic and "qualitative" factors is accentuated. Then also the significativeness of the "small" behavior differences comes into evidence. The mongolian infant, for example, will smile when his chin is touched; but the normal infant may smile responsively without tactile stimulation. Vocalization proves to be more vigorous and varied in the normal; motor tone, motor versatility greater; there is more warmth and vividness to the emotional reactions in social situations; and over a period of time there is a wider range and diversity of exploitive and explorative behavior in the normal infant; more vigor of attack and interest in the environment. The psychologically inacceptable term "quality of attention" is useful in summing up the difference of two such infants with equivalent neuromuscular equipment; for it is in the shifting field of perceptiveness or attention that the superficial parity breaks down.

The accompanying chart of G. I. may serve as a typical mental growth graph of an infant mongol. The first examination was made when the subject was 7 months of age. She passed twenty-four out of thirty-seven items on the 4 months developmental schedule; and earned a full 4 months level rating. Closing on the dangling ring was her maximum achievement. At 1 year of age she reached directly for it. She rated favorably on the 6 months schedule, and bore considerable resemblance to a 6 months infant in her general demeanor. At 18 months she was comparable to a nine months infant; and at 2 years, to a 12 months infant. On this, her final examination, she was cruising about in a nursery walking device. It will take her another year before she is on her independent feet. She has more tricks in her repertoire than the ordinary 12 months baby,

but that is because she has the sociability and mimicry so characteristic of the mongolian, and has had added time in which to acquire her accomplishments. But this is no substitute for developmental capacity. Her developmental




**Growth Graph 20.**

ratio cannot rise above fifty and it is more likely to decline slightly as she grows older. The physical stigmata of mongolism in some of the higher grade cases ameliorate perceptibly with age; but there can be no revival of the normal growth of infancy. That there is, however, even mild amelioration, suggests again that mongolism represents some interference with the natural regulation of normal growth.

### 4. PRECOCIOUS PHYSICAL DEVELOPMENT

Puberty praecox is an unusual developmental condition, which, because of its rarity, has no great importance in the field of child hygiene. It is, however, a condition which bears so directly upon the problem of mental maturation that it requires brief consideration in this chapter.[1] Although it is a highly atypical growth complex, it is not necessarily marked by any pronounced psychological deviations. The case reported herewith is that of a young child who attends school regularly, is normal in appearance and gives no obvious evidence of being in any way exceptional. In her general deportment, play life, and school progress, she is regarded as an ordinary pupil.

The average age of physiological maturation in 48% of 487 high school girls, studied by M. Abernethy, was approximately 13 years, 6 months. The lowest age of maturation in this group was 10 years, and only five instances occurred at that age. Puberty praecox therefore may be defined as an acceleration of physical development in which the signs of physiological maturation occur well in advance of 10 years. In the present instance, these signs occurred at the age of 3½ years. H. J. began to walk at the age of 11 months; and adolescent changes in body proportions were noticed even before this early age. Regularity of menstruation was established prior to the fourth year. She has been markedly in advance of her chronological age in weight and height, and also in physical strength as measured by dynamometer records of her grip. Her countenance is well formed and not exceptional in appearance.

[1] The problem is discussed in greater detail in the following study: Gesell, Arnold: "The Influence of Puberty Praecox on Mental Growth," *Genetic Psychology Monographs*, November, 1926, Vol. I, No. 6.

## 5. THE INFLUENCE OF PUBERTY PRAECOX ON MENTAL MATURATION

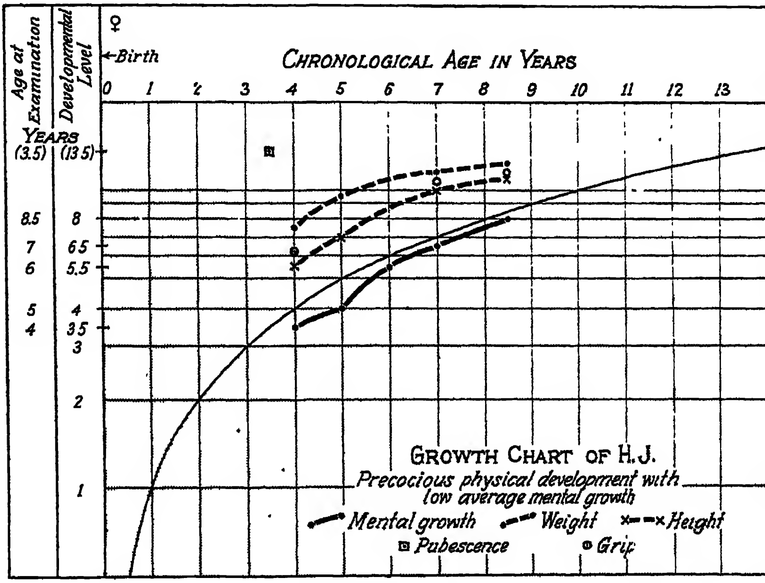
The accompanying table and Growth Graph 21 summarize the annual physical and mental measurements which were made of H. J. A recent examination at the age of 8½ years revealed no new features in the growth picture.

| *Chronological Age at Examinations* . . . . . . . | (1) 4 yrs. | (2) 5 yrs. | (3) 6 yrs. | (4) 7 yrs. |
|---|---|---|---|---|
| *Developmental Items* . . . | AGE LEVEL RATINGS | | | |
| Height . . . . . . . . . | 5½ yrs. | 7 yrs. | . . | 10 yrs. |
| Weight . . . . . . . . . | 7½ yrs. | 9½ yrs. | . . | 11½ yrs. |
| Grip (Right Hand) . . . | 6 yrs. | . . | . . | 11 yrs. |
| Carpal Ossification . . . | 4 yrs. | 6 yrs. | 6 yrs. | 7 yrs. |
| Drawing . . . . . . . | 4 yrs. | 4½ yrs. | 5½ yrs. | 7 yrs. |
| Drawing of Man . . . . . | 3½ yrs. | 4 yrs. | 6 yrs. | 6 yrs. (?) |
| Language and Vocabulary . . | 3½ yrs. | 4 yrs. | 5½ yrs. | 6 yrs. (?) |
| Digit Recall and Knox Cube Test | 4 yrs. | 4 yrs. | 7 yrs. | 10 yrs. |
| Number Sense . . . . | 3½ yrs.(?) | 4 yrs. | 5½ yrs. | 6 yrs. |
| Play Interests . . . . | 4 yrs. (?) | 5 yrs. (?) | 6 yrs. | 7 yrs. |
| School Report . . . | . . | . . | "Average" | "Average" |
| Reading . . . . . . . | . . | . . | 6 yrs. | 7½ yrs. |
| Arithmetic . . . . . . . . | . . | . . | . . | 7½ yrs. |
| General Developmental Level . | 3½ yrs. | 4 yrs. | 5½ yrs. | 6½ yrs. |

The first developmental examination was made when this child was a little less than four years of age. Reëxaminations were made at 5, 6, and 7 years of age; and we are now able to see whether the advanced physical development has had any marked influence on mental maturation.

It is clear from the graph that puberty praecox has had a dislocating effect upon the total growth complex. The statural development is pursuing an unwonted course and the even tenor of mental maturation has been somewhat dis-

turbed. There is no evidence, however, for believing that the precocious puberty has markedly accelerated general mental development. On the contrary the mental examination at the age of 5 years showed a consistent retardation. This examination was made with great pains and there was




Growth Graph 21.

ample rapport with our subject. The subnormality which reflects itself in her "subnormal" 5 year drawing of a man was compensated for by more rapid growth in the ensuing year. Other irregularities express themselves in the memory span for digits, and the span of recall in the cube-tapping test, where the subject was definitely beyond her years.

On each of the five developmental examinations the subject was asked to make a drawing of a man. These

drawings are reproduced in the accompanying figure, because they give a fair indication of the psychomotor maturity found in the five consecutive years, from age 4 to age 8. (See Figure 55.)

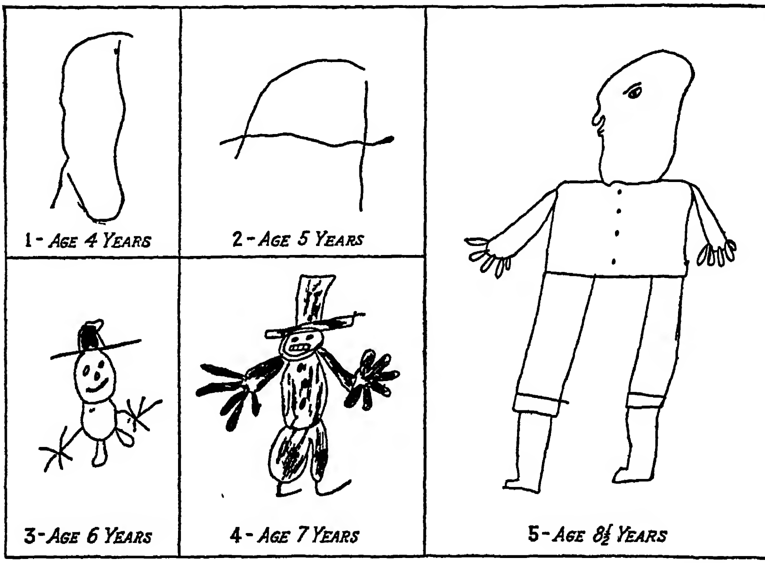



**Fig. 55. — These five drawings of a man by H. J. fairly represent the general course of her mental development.**

**The 4 year effort to make a drawing of a man is rather below the average. Likewise the 5 year drawing, although it shows some improvement. The drawings for 6 years and 7 years approximate the average. It is interesting to note that at the age of 8½ years self-conscious criticism of her drawings, absent in the earlier efforts, appears. She is beginning to draw in profile, and makes repeated attempts to draw a profile which is satisfying to her esthetic sense.**

Closely related to these irregularities are atypical characters in the emotional sphere. Clinically these cnaracters resist precise measurement, but they make a definite impression. H. J. speaks with a voice rich in timbre, deep in tone, and has a grave, restrained poise unusual for her years.

This subdued gravity has a thick, lethargic quality which is unchildlike. This same quality asserts itself in her "mature" adjustment to certain psychological test situations. It seems to enter into her tolerance for and memory of a long row of digits.

She appears to have no vivid self-consciousness. She remarks that at the age of 7 she is much bigger than her 9 year old brother; but she plays with children of her own age. She has shown no special interest in the opposite sex or in younger children, or in dolls. She is not demonstrative with her family. She amuses herself with simple forms of play. Superficially she leads the life of children of her age; but one cannot escape the impression that the emotional complexion of this life has been altered by her unusual physiological status.

A detailed analysis of these alterations is not required for the present discussion. It is sufficient to say that in the general development of intelligence this girl has consistently cleaved to the average or fallen somewhat below in spite of the precocious onset of puberty.

Such physical precocity may apparently alter psychic patterns and introduces affective alterations in the attitudes and in the temperamental susceptibilities. There may even be an unusual increment in the sphere of social development, but there is no corresponding increment in the sphere of mental ability. The changes concern personality as contrasted with intellectual factors; and even these changes are not proportionate to their physiological occasion.

A psycho-clinical study of individual cases of puberty praecox confirms the dynamic importance of the endocrine complex in the determination of behavior. It does not, however, warrant the view which has been advanced that the whole period of growth may be regarded as a function of

sexual development and differentiation. There is a high degree of specificity, even of independence, in the components of the growth complex. Puberty plays its part; but not with unlimited autocracy.

The nervous system among all the organs of the body manifests a high degree of autonomy, in spite of its great impressionability. It is remarkably resistant to adversity, even to malnutrition. This relative invulnerability gives it a certain stability in the somatic competition between the organ systems. It tends to grow in obedience to the inborn determiners, whether saddled with handicap or favored with opportunity. For some such biological reason, the general course of mental maturation is only slightly perturbed by the precocious onset of pubescence.

### 6. A CASE OF THYROID DEFICIENCY

The case of I. K. is of unusual interest. This child was referred to us for developmental examination when she was 6 months of age, by Dr. Ethel Dunham of the Department of Pediatrics of the Yale School of Medicine. The diagnosis at that time, justified since by extended therapeutic test, was hypothyroidism. The child is now approaching three years of age and has accumulated a remarkable growth history. Sixteen developmental examinations have been made in this period and the findings have been carefully organized and estimated by Miss Elizabeth Lord, Clinical Examiner of the Yale Psycho-Clinic.[1]

The first developmental examination was made when I. K.

[1] It is planned to bring these findings into relation with other medical aspects of the case which will be reported in detail by Dr. Ethel Dunham. I am indebted to Dr. Dunham for her coöperation in making the present brief report, which is designed to illustrate the possibilities of bringing methods of developmental study into clinical pediatrics. There is a large field for systematic, normative investigation of the developmental aspects of the diseases and disorders of infancy.

was 6½ months of age, ten days after the initiation of thyroid treatment. Her body length was 60 centimeters, her weight 5960 grammes. She presented a pronounced picture of reduced behavior. She was definitely less reactive than a healthy one month infant. She clasped a cube, but only feebly and only on tactile contact. She did not follow a moving object with her eyes, not even a flash light. Arm and leg movements were frequent but lacked vigor and variety. There was a slight decrease in activity with change of facial expression to suggest that she heard and attended her father's voice. She fixated her head responsively to sound.

Her behavior was superficially most comparable to that of a one month old infant. She "failed" on seven out of eleven items on the 2 months developmental schedule; and did not score a single positive rating on the 3 months schedule. This extreme degree of subnormality ordinarily denotes grave and permanent mental deficiency.

The early improvement under thyroid treatment was dramatic and out of all proportion to an ordinary rate of development. The second examination was made only 3 weeks after the first, but the behavior picture advanced to the 3 months level. There was marked increase of activity. The child held and regarded a rattle. She played with her hands, she smiled, even vocalized responsively, to social stimulation. She laughed. With crude coördination, but adaptively, she closed in on the dangling ring. Her motor control was below the level of her adaptive behavior. She lifted her head only momentarily when prone, and made no effort to raise herself to the sitting position. Her head and body posture was limp.

On the third examination at the age of 9 months she was developmentally rated at the 4 months level, a consistent

gain. On the fourth examination, at the age of 11 months, she showed improvement in spite of a severe attack of whooping cough.

At the age of one year when the thyroid intake had been increased to four grains daily, there was further acceleration of the developmental rate. At that age I. K. not only perceived a pellet, but raked it up from the table. She sat momentarily without support. She lifted her head and chest when prone. She could be rated slightly above the 7 months level. Socially her behavior was somewhat in advance of this level; she played pat-a-cake and waved bye-bye. She looked differentially in the direction of mother, father, and grandmother as they were named. She imitatively articulated da-da and ma-ma.

Even this condensed summarization of the behavior progress has perhaps exaggerated in the reader's mind the lapse of time between the first and the fifth examinations. It should be noted that this striking change in the behavior picture from a condition of severe defect was accomplished in the short space of 6 months. It is difficult to believe that the feeding of thyroid had no causative relation to this most uncommon course of behavior events. To sense the significance and the degree of developmental improvement it is only necessary to recall that the relatively reactive year old child was, at the age of 6 months, most comparable in her behavior to a one month old infant.

The subsequent growth career is recapitulated in the accompanying graph and in the tabular summary. It will be noted that the curve of general developmental level shows a cumulative upward trend, which is not duplicated in any of the numerous growth studies discussed and graphed in foregoing chapters. This progressive cumulation lifted the developmental quotient (D. Q.) from 15 at the age of 6

months to 82 at the age of 20 months. In the interval between 20 months and 33 months inclusive, 8 developmental examinations were made and the quotients were calculated to summarize the findings. Two of these quotients register a depression which appears from the history to be associated with reduction or irregularity in the intake of the prescribed thyroid. The amount of thyroid administered is indicated along the chronological age line of the chart. (Growth Graph 22.) This graph therefore brings into correlation both physical and mental aspects of a significant growth complex.

### 7. CUMULATIVE IMPROVEMENT IN DEVELOPMENTAL STATUS

The psychological findings of the whole series of developmental examinations can be most succinctly reviewed by means of a tabular summary.

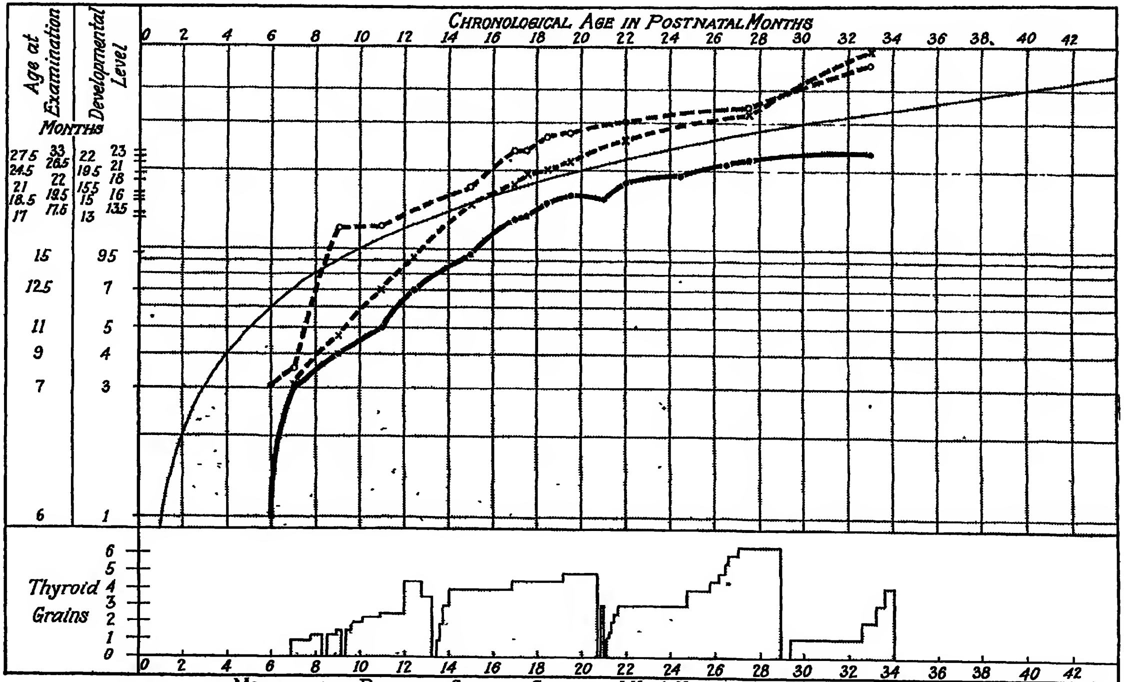
#### Summary of Developmental Progress of I. K.

The results of the sixteen developmental examinations are briefly indicated by means of illustrative behavior items, and by designation of the chronological age (Age), Developmental Level (D.L.) and Developmental Quotient (D.Q.). The ages and levels are expressed in months and decimal fractions. It should be understood that the fractions of the developmental ages express not the precision of the measurement but the shadings of the clinical estimates based on the normative findings.

*First Examination. Age 6.5 months. D.L. 1 month. D.Q. 15.* Occasional feeble movements of arms. Feeble grasp of objects inserted in her hands. Only occasional sounds. Does not raise head, follow moving objects or flash light. Does not cry vigorously.

*Second Examination. Age 7.2 months. D.L. 3 months. D.Q. 40.* Grasps dangling ring. Waves rattle. Vocalization increased by social stimulation.

*Third Examination. Age 8.7 months. D.L. 4 months. D.Q. 46.* Plays with rattle and recovers it when near. Smiles. Increased vocalization. Reaches promptly for objects. Laughs. Holds head erect but does not hold back upright (in seated position).




Mental and Physical Growth Graph of I.K.,–A Hypo-thyroid Infant
*Showing the Results of Thyroid Treatment From 1 Month to 33 Months*

*Normal average* *Mental growth curve* *Height* *Weight* *Thyroid intake*

**Growth Graph 22.**

*Fourth Examination. Age 11 months. D.L. 5 months. D.Q. 45.* Grasps objects but not vigorously. Splashes and kicks in bath. Holds back upright (in seated position).

*Fifth Examination. Age 12.5 months. D.L. 7 months. D.Q. 57.* Plays pat-a-cake. Looks at person named. Reaches fairly persistently for objects. Sits alone momentarily, rolls over.

*Sixth Examination. Age 15 months. D.L. 9.5 months. D.Q. 63.* Vocalization increased and social in character. Bangs objects together, tears paper. Can pull self to sitting position. Does not creep.

*Seventh Examination. Age 16.7 months. D.L. 13 months. D.Q. 77.* Recovers cube under cup or wrapped in paper. Taps paper with crayon. Drops rod in hole. Pushes circle into form-board. Hitches.

*Eighth Examination. Age 17.5 months. D.L. 13.5 months. D.Q. 77.* Adaptation similar to previous examination, attempts to place one cube on another. Repeats six words.

*Ninth Examination. Age 18.5 months. D.L. 15 months. D.Q. 80.* Piles one cube on another. Scribbling. Looks at pictures for prolonged period.

*Tenth Examination. Age 19.5 months. D.L. 16 months. D.Q. 82.* Uses four words. Occasionally builds tower of 3 blocks. Spontaneous scribbling. Shoves square into form-board.

*Eleventh Examination. Age 21 months. D.L. 15.5 months. D.Q. 73.* Less good results in several situations. No improvement.

*Twelfth Examination. Age 22 months. D.L. 18 months. D.Q. 81.* Stands momentarily alone. Uses four to five words. Adjusts circle to form-board. Persistent effort to pile blocks.

*Thirteenth Examination. Age 24.5 months. D.L. 19.5 months. D.Q. 79.* Walks unsteadily. Tries to pile blocks. Places three forms in form-board. Obeys simple commands, *i.e.*, "Put it in the cup . . . in the plate."

*Fourteenth Examination. Age 26.5 months. D.L. 21 months. D.Q. 79.* Name for many objects. "Bye-bye. — hat-coat." Combination of words reported. Named dog on card, "Sparkie" and names pictures at home, *i.e.*, "auto, baby, Sparkie." Difficulty in piling, but once made tower of four blocks.

*Fifteenth Examination. Age 27.7 months. D.L. 22 months. D.Q. 79.* Joins words "ide bile" (ride auto). Interest in pushing blocks as a train. Tower of four blocks twice in seven minutes play.

*Sixteenth Examination. Age 33 months. D.L. 23 months. D.Q. 69.* Combines words, "me want ——" Piles three blocks. Adapts form-board. Names few animals in book. Walks short distances on street.

It will be noted from the foregoing summary that there is a consistent improvement in developmental ratings till the age of 20 months, a temporary lapse at 21 months, with sustained status till the age of 33 months. The two depressions in the developmental quotient occur at the eleventh and the sixteenth examinations. During the month preceding the twelfth examination, the mother, influenced perhaps by the good showing just made by her daughter, gave the thyroid irregularly and reduced the dose from five to three grains. At the age of 22 months the developmental quotient returned to a level of approximately 80, where it remained for a half year, until the age of 28 months.

The last examination, at the age of 33 months, showed a drop in the quotient to 70, and symptoms of fretfulness and irritability. In the interval of 5 months there had been marked irregularity in the thyroid intake. For the first 5 weeks of the interval a maximum dose of six and a half grains was tolerated. Thyroid was then omitted for two weeks, and resumed to the amount of one grain only daily. Since then the dose has been increased and the reaction to this increase may perhaps confirm the suggestion that the developmental ratings have been quantitatively affected by the variations in thyroid feeding.

## 8. THE RÔLE OF THYROID

Pending the accumulation of further developmental history, only brief comment should be made on the present case. It is evidently a case of hypothyroidism, which has benefited from the fact that diagnosis was made at a date much earlier than is usual. Whether it is a genuine case of cretinism in the classical sense is not so clear. The temperamental and emotional features among others are not characteristic. At any rate it is not certain that the condition is

one of true retardation. It is suggested that the dynamogenic capacity is impaired as well as the growth capacity. In other words the thyroid deficiency is not only curtailing development as such, but is interfering with the production of normal energy and the utilization of the existing equipment of the organism. The condition, although in no sense identical with ordinary debility, may basically resemble debility more than imbecility. It can then be characterized as reduction of behavior rather than retardation of development. Similarly in certain cases of adult hypothyroidism, we interpret the symptoms in terms of hebetude rather than in terms of reversion to more primitive developmental level. It is not without significance that qualitatively the behavior of I. K. assimilates more readily with normality than with mental deficiency.

### 9. THE INFLUENCE OF RICKETS AND MALNUTRITION

Rickets is one of the most common of all disorders of growth. It is almost as common as dental caries. The term "rickets" comes from an old English word "wriccken," which means twist. The effect of rickets on bony structures is well known. The question arises whether rickets also influences functional aspects of development.

Severe rickets, because of the disturbance in calcium metabolism, and because of its recognized relation to tetany and childhood convulsions, must inevitably have some effect upon the nervous system during the active stages of the disorder. Older writers even went so far as to suggest that rickets might be a causative factor in producing certain cases of amentia. There is, however, no foundation for this statement, and there are no conclusive data concerning the permanent effect of rickets upon mental development.

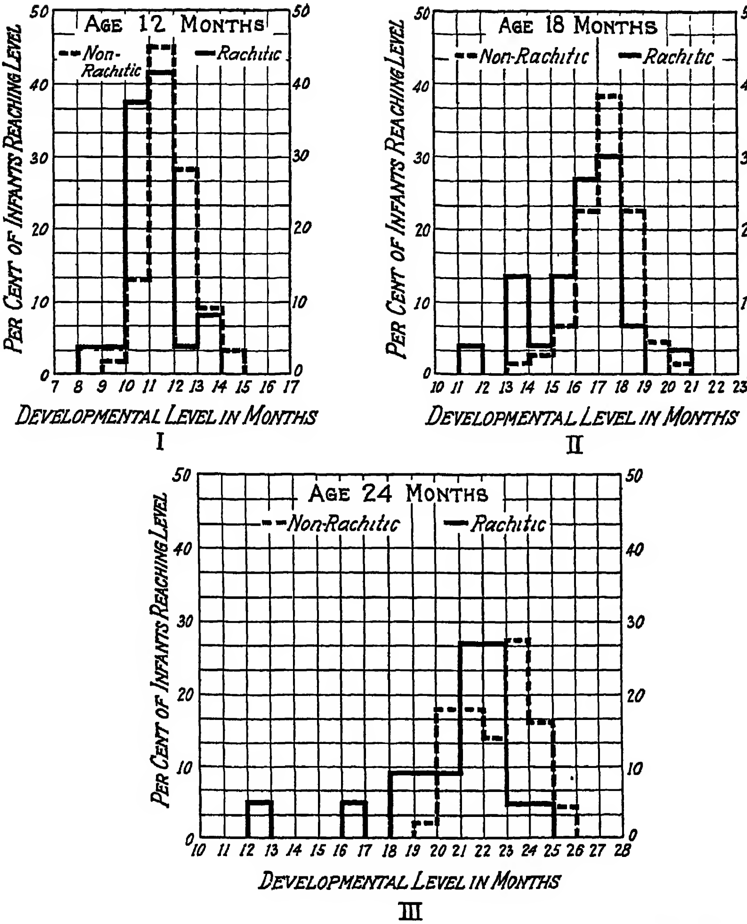
The whole problem of the psychodevelopmental conse-

quences of rickets, however, is one of medical and practical importance. It has been subjected to some systematic study in connection with the New Haven Rickets Investigation and Demonstration under the auspices of the Federal Children's Bureau and the Department of Pediatrics at Yale University. Miss Florence Ullman, formerly child psychologist of the bureau, is making preliminary report of her findings based upon developmental examinations of 258 children. These children included rachitic and nonrachitic groups for comparison at the 12 months, 18 months, and 24 months levels. The developmental examinations were detailed and comprehensive, and furnished ratings on numerous items in the motor, language, adaptive, and personal-social fields of behavior. When these findings were tabulated for parallel comparison, it was found that there was only a slight discrepancy in favor of the nonrachitic group. Even in the motor fields of the behavior, the difference was not as great as the clinical literature, with its emphasis on delayed walking, suggested.

In order to eliminate as many variable factors as possible, the investigator carefully paired selected children, equalizing the pairs so far as possible on the basis of age, sex, nationality, race, and social status. Fourteen cases in the 12 to 18 months group were paired. The results indicated a slight superiority in the ratings of the nonrachitic group at both of these age levels. Seven cases were similarly paired in the 18 to 24 months group. This comparison showed less discrepancy in the ratings of the nonrachitic versus the rachitic group.

The comparative findings for the rachitic and nonrachitic groups are partially summarized in the accompanying table and in Graph 23.[1] The table lists a dozen different

[1] The reader must be referred to a forthcoming government report for a more adequate and critical summary of the data and findings.




Growth Graph 23. — These comparative graphs showing the relative developmental status of 3 age groups of rachitic and nonrachitic infants examined in the New Haven rickets study. The children in graph I were 12 months old; in graph II, 18 months old; in graph III, 24 months old. The ratings of maturity and behavior level were based on detailed developmental examination, and are plotted on the horizontal axis. The percentage of infants attaining each level is indicated along the vertical axis.

phases of walking ability in a genetic order of difficulty and classifies the two groups on the basis of these seriated specifications. The percentage distributions can be easily read from the table.

These infants were examined in 3 age groups as follows: 78 at the age of 12 months; 105 at the age of 18 months; 72 at the age of 24 months. Specific items of walking ability are arranged in the main column in a descending order of difficulty. The percentage of rachitic (R.) and nonrachitic (N.R.) infants who possess each of these locomotor abilities is indicated in the age columns.

TABLE SHOWING THE COMPARATIVE WALKING ABILITIES OF RACHITIC AND NONRACHITIC INFANTS

| WALKING ABILITIES [Determined by test and observation] | 12 mos. | | 18 mos. | | 24 mos. | |
|---|---|---|---|---|---|---|
| | N. R. | R | N. R. | R. | N. R. | R. |
| Plays in yard when watched. Runs about. . . . . . . . . . | .... | .... | (2.67) | (0.00) | 20.00 | 13.64 |
| Walks easily. Gait no longer infantile . . . . . . . . . . . | .... | .... | 33.33 | 0.00 | 84.00 | 31.82 |
| Runs . . . . . . . . . . . | .... | .... | 42.67 | 30.00 | 66.00 | 59.09 |
| Walks up and down street if attended | .... | .... | 62.67 | 53.33 | 16.00 | 13.64 |
| Walks all around house. Seldom falls . . . . . . . . . . . | 7.41 | 0.00 | 57.33 | 20.00 | 96.00 | 50.00 |
| Walks alone. Still toddles. Prefers walking to creeping . . . | 9.26 | 4.17 | 82.67 | 43.34 | 98.00 | 72.73 |
| Walks alone. Balance fair. Lifts feet in infantile style . . . . | 14.81 | 8.33 | 96.00 | 83.33 | 98.00 | 81.82 |
| Walks alone a few steps (from person to person). Starts self . . . | 31.48 | 12.50 | 96.00 | 86.67 | 100.00 | 86.36 |
| Walks with help (from chair to chair or with slight support). Impulse to go forward . . . . . | 66.67 | 41.67 | 98.67 | 93.33 | 100.00 | 90.91 |
| Walks forward a bit when firmly supported . . . . . . . . | 90.74 | 79.17 | 98.67 | 96.67 | 100.00 | 100.00 |
| Makes vigorous stepping movements but lacks urge to go forwards . | 94.45 | 87.50 | 100.00 | 100.00 | .... | .... |
| Stepping movements feeble. Not very spontaneous . . . . . | 100.00 | 100.00 | .... | .... | .... | .... |

These findings suggest that the retardational effect of rickets is less than is commonly supposed, and is transient in character. Although sweeping conclusions must be avoided, it appears that rickets, like other forms of malnutrition, alters and depresses the behavior output, but does not greatly curtail or arrest the basic maturation of the nervous system. While some nutritional disorders undoubtedly disturb the course of development more than others, the nervous system apparently has considerable immunity against the adversities of faulty or impoverished nourishment. This is a factor of safety and fortunately protects the child from undue permanent handicap from the all too frequent disorders of early nutrition.

# CHAPTER XIV

# TWINNING AND GROWTH REGULATION

## Some Developmental Aspects of the Physiology of Twinning

If it is in her moments of abnormality that nature reveals her secrets, as Goethe remarked, then that peculiar form of bodily asymmetry, called hemihypertrophy, assumes an added piquancy of interest. Hemihypertrophy is one of the rarest of medical anomalies; but it is an anomaly which might well disclose some glimpse of the inner mechanics of development. It is a variant of the biologically almost universal process of twinning. Hemihypertrophy bears directly on the basic problem of growth regulation and throws light on certain embryonic conditions which determine normal bodily and mental development.

### I. THE NATURE OF HEMIHYPERTROPHY

Hemihypertrophy is essentially a developmental anomaly. It antedates birth and arises in some way as a partial deflection of the normal processes of growth. It strongly suggests a curtailed enlargement of one-half of the soma, a hemimacrosomia. As such we may interpret the condition to be an atypical or a paradoxical form of twinning, a hybrid variant of the same process which may produce a double monster or a completely symmetrical individual. The biological paradox consists in this, that such hemihypertrophy is neither double monstrosity nor bilateral duplicity; it is

half of each, as though the individual remained two conjoined hemicreatures, each with a discrete though half realized genetic destiny.

The writer has been able to study two examples of this curiously interesting developmental deviation. One case is that of an adolescent boy who has been under observation for 12 years, between the ages of 13 and 25. The other is a young girl, examined at 2, 3, and 4 years of age. In both instances, significantly enough, the hemihypertrophy was associated with a reduction of normal mental growth. We shall discuss the interrelation of the bodily and the mental features of this unusual growth complex.

Symmetry is not a problem which belongs alone to aesthetics. It interests the biologists because all growing organisms tend to take a certain balance of form. In this sense symmetry is a dynamic phenomenon, a physiological product to be studied as a phase of developmental mechanics. Indeed, symmetry has become a problem of experimental research in biology; and the closely related problem of twinning is almost a subscience. Hemihypertrophy is a clinical condition in which nature has virtually performed a striking experiment in the field of symmetry and twinning. For all its rarity, this condition bears upon phenomena of wide import.

## 2. CLINICAL EXAMPLES OF HEMIHYPERTROPHY

Before proceeding to a discussion of the developmental significance of hemihypertrophy, two cases will be briefly described.

1. B. D., a young girl, was referred to our clinic because of difficulty in walking at the age of 2 years. Reëxaminations were made when she was 3 and 4 years old. Physically she was a well-nourished child, relatively normal in general

Fig. 56

Fig. 57

Fig. 56. — Hemihypertrophy in a girl (B. D.), age two years, showing enlargement of the entire left half of the body, from head to foot.

Fig. 57. — Hemihypertrophy in a boy (C. E.), age thirteen years, showing similar generalized hypertrophy of the right half of the body. In both children the physical asymmetry (minimal twinning) was associated with retarded mental growth.

appearance, and without any unusual medical history. She walked awkwardly, frequently stumbling, and limped perceptibly. The limping proved to be due to the disproportionate length of the left leg. The disparity was sufficiently marked to cause the orthopedic clinic to recommend a built-up shoe for the right foot. Since then the motor difficulty has been largely overcome; but it caused much embarrassment in the early stages of walking.

Physical inspection as well as measurements showed that the asymmetry was of a total unilateral character, and that the whole left side was hypertrophied. Roentgen ray photographs showed that the bony as well as soft tissues were involved. The tongue was markedly hypertrophied to the left of the median line, and there was a definite corresponding convexity in the left lateral aspect of the lip. The tongue deviated to the right side on extrusion.

To ordinary inspection there was no difference in the teeth. There were eight on each side, with caries more advanced on the left side. The left half of the nose and the left nares were perceptibly larger. The left half of the abdomen was distinctly fuller. Palpation in the median line near the umbilicus showed *diastasis recti*, admitting the finger tips. No areas of cutaneous congestion or deviations with regard to hair distribution were noted in the examination of the skin.

A tabulation of the significant measurements follows. These include comparative measurements of the bones, made directly from the Roentgen ray negative.

*Mental Development:* A careful examination of B. D. was made when she was 2¼ years of age, and again when she was 3 years and 4 years of age. Her mental development has shown consistent retardation, and justifies a diagnosis of mental defect of high grade.

On the first examination when her chronological age was 2¼ years, her developmental level approximated 18 months. At the chronologic age of 3 years her developmental level had reached 2 years. At the chronologic age of 4 it had

TABLE OF PHYSICAL MEASUREMENTS OF B. D.

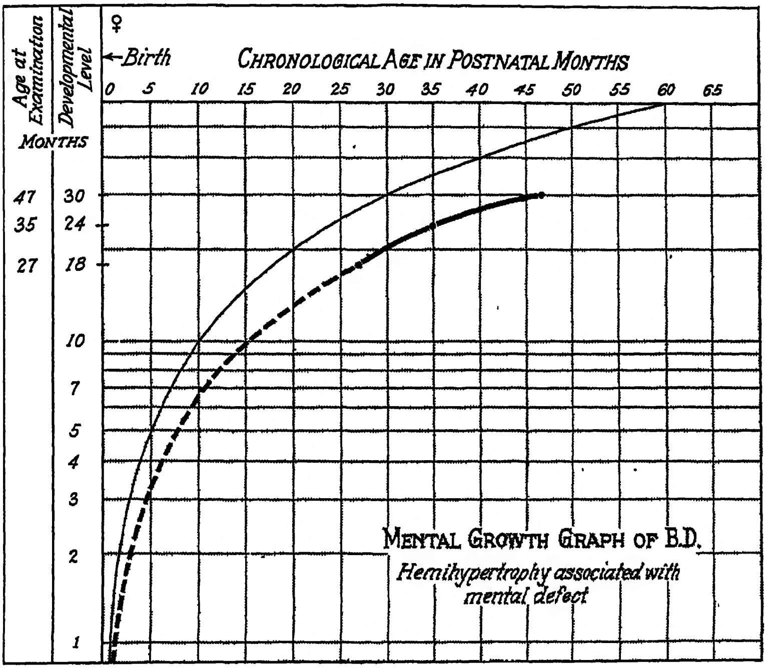
| ITEMS | | RIGHT | LEFT |
|---|---|---|---|
| Height | 83 cm. | | |
| Weight | 14 kg. | | |
| Cephalic girth | 47 cm. | | |
| " breadth | 13 cm. | | |
| " length | 14.5 cm. | | |
| Length of leg | ... | 39.6 cm. | 41.2 cm. |
| " femur (Roentgen ray) | .... | 20 | 21 |
| " tibia " | .... | 16 | 16.5 |
| " fibula " | .... | 15 | 15.7 |
| Thigh girth | .... | 29 | 32 |
| Calf girth | .... | 21 | 22.2 |
| Length of arm | .... | 37.5 | 40 |
| " humerus (Roentgen ray) | .... | 13.2 | 15.2 |
| " radius " | .... | 11.2 | 11.5 |
| Biceps girth | .... | 18 | 19 |
| Hand girth | .... | 14 | 15 |
| Length of foot | .... | 12.4 | 13.4 |
| Width of foot | .... | 4.5 | 5.1 |
| Length of ear | .... | 5.7 | 6 |
| Width of palpebral fissure | .... | 0.8 | 1 |
| Carpus Ossification Areas: | | | |
| Magnum | .... | 7 x 8 mm. | 5 x 7 mm. |
| Unciform | .... | 6 x 8 | 5 x 8 |
| Cuneiform | .... | 4 x 5 | 3 x 4 |
| Semilunar | .... | 3 x 3 | absent |

reached approximately 2½ years. At each developmental examination, therefore, the developmental quotient was approximately 65. (See Growth Graph 24.)

2. C. E., a boy, first came under our observation at the age of 13 years and has been followed for 12 years. Measurements were made at the ages of 13, 20, and 25. He presented a well-defined condition of hemihypertrophy. It

involved both soft and hard tissues on the right side and was associated with characteristic areas of congestion in the skin, and with mental defect.

The right ear was appreciably longer than the left; the right half of the nose markedly larger; the right nostril




Growth Graph 24.

twice the left in diameter; the right palpebral fissure was wider; on the same side the cheek and lips were fuller and the arm was longer.

Roentgen photographs of hands and feet were taken, and showed that the bones in each case were consistently larger and longer on the right side.

Fig. 58. — Roentgen ray photograph of the hands of B. D.

Fig. 59. — Palm prints of the hands of C. E., showing marked disparity in size, but identity in the configuration of the friction ridges. The pattern formula for these ridges derived by Wilder's method is in each hand: 11. 9. 7. 5. C.

Palm prints of the right and left hands were taken, and the friction ridges were mapped by Wilder's method. The accompanying photograph shows the marked disparity in the size of the two hands; but what is more significant, it shows that the configuration of the friction ridges is identical. This suggests that the hemihypertrophy is due specifically to a failure of size regulation. (See Figure 59.)

The physical and mental measurements were made at 13, 20, and 25 years of age. These measurements are summarized in the accompanying table. From these figures it

Comparative Table of Measurements, C. E.

| Items | 13 Years | 20 Years | 25 Years |
| --- | --- | --- | --- |
| Height | 58 in. | 67 in. | 67 in. |
| Weight | 87 lbs. | 137 lbs. | 145 lbs. |
| Dynamometer, R. hand | 15 kg. | 31 kg. | 34 kg. |
| Dynamometer, L. hand | 11 " | 22 " | 22 " |
| Right arm length | 63 cm. | 77.5 cm. | 77.5 cm. |
| Left arm length | 61 " | 75 " | 75 " |
| Right wrist, girth | 14 " | 16.5 " | 16.5 " |
| Left wrist, girth | 13 " | 14.5 " | 14.5 " |
| Right hand, girth | 21 " | 23 " | 23 " |
| Left hand, girth | 18.5 " | 20 " | 20 " |
| Intelligence Age | 4½ yrs. | 5½ yrs. | 5½ yrs. |
| Intelligence Quotient | 36 | 35 | 35 |

appears that hemihypertrophy is a relatively stable condition. This stability illustrates forcibly the fact that a physical deviation acquired in the prenatal period may project itself through the whole growth cycle. The measurements at 20 and at 25 years were virtually identical. There were slight differences in the girth measures due to increase in weight, but there was no apparent change in the degree of disparity. Morphologically, this condition does not during childhood and youth undergo either a progressive or an

equalizing tendency. The period for such regulation of symmetry was in utero. The asymmetry can not be outgrown. There are many other organic characters of which the same can be said.

### 3. THE CAUSES OF HEMIHYPERTROPHY

What is the cause of hemihypertrophy? Since the true cause is unknown, there is no dearth of etiologic theories. These "explanations" range from maternal impressions to internal secretions. A German mother ascribed the hemihypertrophy in her son to the fact that during pregnancy she had seen a youth of gigantic proportions in the market place. Presumably she saw only one side of this giant.

One writer attributes hemihypertrophy to an inherent tendency of the tissues to appropriate an excess of nutriment, but, as Ballantyne remarks, this statement is more ingenuous than ingenious.

Fortescue-Brickdale advances a venturesome biochemical theory. He suggests that the condition is due to an irregular distribution in the tissues of the anchoring substance which interacts with the glandular secretions which determine growth.

Another group of theories ascribes the hypertrophy to vascular lesions, calling attention to the frequency of vascular and skin complications and to the analogy of "naevus neuroticus unius lateris." One view is that an embryonic disturbance establishes a preëminence in the blood supply of one side or one part. Once established, this preëminence causes a permanent overgrowth of the favored side. This explanation is similar to that which ascribes right-handedness to the richer blood supply of the left hemisphere. Partial vasomotor paralysis has been suggested (Virchow); also incomplete development of the middle arterial coat. Pollosori

regards a disturbance of the lymphatic system as the etiological factor. But if the lesion is a vascular one, what is its origin? Is it hereditary?

There is no evidence that hemihypertrophy is hereditary. Burns found only one case in the literature in which macrodactylism was present in several members of a family. There is one record of a family with apparently hereditary enlargement of the left hand, but we know of no instance in which two members of the same family or related members presented hemihypertrophy. To be hereditary the differential cause of a character must be present in the germ cell. Hemihypertrophy is congenital, but in origin it is probably embryonal and not germinal.

Hemihypertrophy may easily date back to some disturbance during the early embryonic period. The results of experimental teratology have shown that gravity, pressure, and other influences may induce monstrosities of various kinds. It is conceivable that a slight deviation from the harmony of physical influences surrounding the embryo, may be competent to initiate a partial or unilateral hypertrophy in ways similar to those demonstrated in the laboratory. If the influence is teratologic, it may well go back as early as the fourth week in the embryonic period during the cleavage of the mesoblastic somites.

Although these various theories are suggestive, it seems to us that hemihypertrophy can be most profitably interpreted as an imbalance of the normal process of twinning which underlies all bilateral symmetry. From this point of view, hemihypertrophy is an epigenetic deviation rather than a germinal deformity. It represents some defect of the inner organismic regulation, or some disparity in the intimate environmental factors exerted in the early stages of cleavage. It is, accordingly, not an altogether unique

anomaly but may be brought into the category of twinning and of double monstrosity.

### 4. HEMIHYPERTROPHY AS A PHASE OF TWINNING

We turn then to a consideration of some of the phenomena of twinning which play such an important rôle in developmental physiology.[1]

Bateson has given us a very broad conception of twinning in his formula "the production of equivalent structures by division." He regards it as a fundamental manifestation of life. "When I look at a dividing cell, I feel as an astronomer might if he beheld the formation of a double star: that an original act of Nature was taking place before me." Cellular division, as such, is not twinning; but the tendency of the divided or repeated parts to assume symmetrical relations may be so regarded; and this tendency is an almost universal feature of biologic mechanics. The fact that the experimental embryologist can bring about the growth of a paired structure by a simple incision of a single limb bud reveals the fundamental nature of twinning. Of similar significance is the fact that Loeb produced a 90 per cent increase in twins by a simple immersion of his experimental eggs in lime-free sea water, which caused the segments of the living eggs to fall apart as they were formed. Newman, likewise, regards the phenomenon of twinning as a "very fundamental process almost universal in the field of biology. For wherever we have bilateral doubling, we have twinning in some form."

[1] For more extended discussion and bibliographies the following references may be consulted:

Gesell, Arnold: "Hemihypertrophy and Mental Defect," *Archives of Neurology and Psychiatry*, 1921, Vol. 6., pp. 305–344.

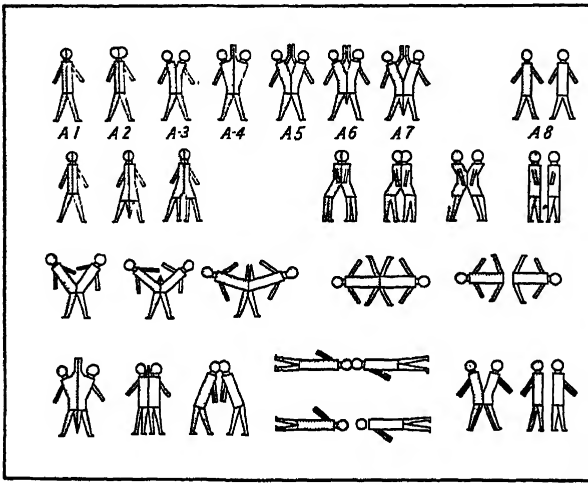
Gesell, Arnold: "Hemihypertrophy and Twinning," *American Journal of the Medical Sciences*, 1927, Vol. 173, pp. 542-557.

From this point of view every bilateral individual may almost be considered as being morphologically a pair of twins. This view is so legitimate that it need not be called paradoxical. The human individual is undoubtedly derived from a single fertilized cell. He is monozygotic in origin. From this zygote, through a process of symmetrical division, develop all his right and left hand homologous organs and the right and left halves of his "unpaired" organs and structures. He is a product of developmental duplicity. Now in the case of true, complete monozygotic twins, this process of duplication has been carried to such a degree that two offspring result from the single ovum. A perfectly symmetrical bilateral individual on the one hand, and a perfect pair of duplicated individuals on the other, represent the ideal extremes of the process of twinning. Between these extremes there are many gradations and deviations, some of them benign, others monstrous, in character. Instead of a full twinning of the whole body, there may be twinning of various parts or only of one part. For example in the type of twinship known as *diprosopus diopthalmus*, described by Ballantyne, "the size of the head and the presence of two noses may be almost the only signs of duplicity."

Wilder has studied the genetic relationships between monozygotic twinning and double monsters (diplopagi). A gradation of the interrelations of various sorts of diplopagi and duplicate twins is diagrammatically pictured in the figure on page 284 (Figure 60). This diagram does not exhaust all of the possibilities, and does not aim to embrace those instances where one twin is included by the other, or where one twin becomes a mere parasite upon its normal co-twin. Incidentally, it may be recalled that such a parasite may degenerate into an acephalic, acardiac, trunkless, or

amorphous mass. Here, as Ballantyne remarks, Nature "attains to the extreme limit of teratologic expression."

Twinning, therefore, is a highly variable process which expresses itself on an enormously wide gamut. It may produce perfect symmetry and mirror imagery; or it may produce



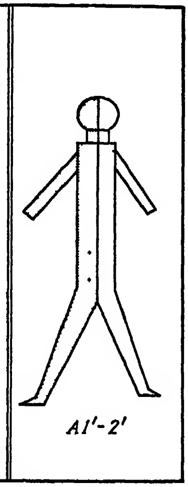




Fig. 60. Fig. 61.

**Fig. 60. — Diagram showing both normal and aberrant growth regulation in monozygotic twinning. (From H. H. Wilder, *American Journal of Anatomy*, vol. 3, p. 473.)**

**Fig. 61 (at right). — Diagram of author's case of hemihypertrophy (C. E.), suggesting that this condition is a variant between stages A-1 and A-2 in Wilder's series.**

gross disparity. Nowhere in the study of man do we find such complete duplication of individuality as among monozygotic twins; and nowhere do we find also such profound and monstrous degrees of individual difference as among twins derived from the selfsame egg. By the same token we may expect to find mild degrees of monstrosity or of

incipient monstrosity such as hemihypertrophy embodies. We might then add to Wilder's diagrams a silhouette of an individual whose morphological eccentricity is indicated by a larger and a lesser half. (See Figure 61.)

The studies of Stockard, like those of Wilder, have concretely shown the close genetic relationships between monozygotic twinning and double monstrosity. Stockard has experimentally produced in the trout and in the sea minnow unilateral deformities of development which resembled hemihypertrophy. He was able to arrange specimens of his experimental fish in graded series, demonstrating "a continuity of the series from *monstra in defectu* through the simple normal individuals to *monstra in excessu* and finally identical twins."

Stockard holds that the specific rate of development in any animal is probably dependent upon the rate of oxidation in the protoplasm of the species. Experimentally, therefore, the rate of development may be retarded by lowering the surrounding temperature, which reduces the rate of oxidation. Stockard found that "practically any deformity recorded in the literature other than those resulting from germinal variations or mutations may be induced by lowering the temperature and thus modifying the developmental rate."

The exact manner in which these developmental deviations are accomplished, is differently interpreted by different biologists. The tendency of recent research is to stress not the inherent molecular constitution of the germ, but the reaction of the specific growing protoplasm to the immediate environmental conditions. R. S. Lillie has suggested that the process of development is basically regulated by some physiologic influence of a repressive or inhibitory kind comparable to chemical-distance-action, which is indeed essentially a form of bio-electric control through potential

difference. C. N. Child has elaborated the concept of the physiologic gradient.

This concept affords some clue to the mechanism of hemihypertrophy, or at least to its rationalization. Child asserts that at present there is "no evidence to indicate that axiate pattern can arise in any other way than as a gradient in a physiologic state." Polarity and symmetry therefore are dependent primarily upon "'quantitative dynamic gradients in living protoplasms," whose existence Child has experimentally demonstrated, in numerous ways. Accordingly, "physiologic dominance" and "physiologic isolation," and the relations between them are the dynamic factors which determine form regulation, symmetry, and frequently duplication and reduplication. Or one dominant region, because of its shape, may split into two regions of physiologic dominance, which will result in a greater or less degree of twinning. The range of dominance also plays a rôle in determining the limit of individual size. Since the concepts of gradient, dominancy, and isolation are essentially quantitative, it follows that a slight quantitative imbalance in the early stages of embryonic cleavage, might project itself into the whole-growth cycle as either a partial or a total unilateral asymmetry.

Although one speaks of total hemihypertrophy as though it were a defined clinical entity, it should be emphasized that even among the relatively small number of cases recorded in the literature, there is an impressive range of variation. One case will show a few nevi, another extensive nevi, another will report the skin to be entirely normal. In some cases the vascular complications are conspicuous, in others wanting. The fact that hemihypertrophy is associated with both normal and defective mentality also is noteworthy.

Does not this variability in associated symptoms suggest that the condition arises out of environmental or epigenetic conditions? Growth is constantly regulated by interacting factors, and the specific structural features of any given case of hemihypertrophy will depend upon the precise moment at which the disturbing influence began to operate. The severity of the cerebral arrest, for example, will depend upon the dominance or the developmental stage of the neurogenic portions of the embryo. We are thinking here of subtle inhibitions or arrests of growth in the morphogenetic interplay of various organ systems, or even in the several components of a complicated system like the cerebrum. If grosser teratologic suppressions occur, subtler alterations are theoretically even more certain. On the grosser scale, Stockard, for example, found that the initial growth which gives origin to an embryonic system such as the brain and spinal cord "is linear in type, until a definite length is attained when linear growth subsides. This is followed by a series of lateral outgrowths in consecutive fashion. These lateral outgrowths from the central nervous system may be experimentally suppressed by slowing development at definite times . . ." The constantly changing status of the embryonic organs and the sensitiveness of the dynamic equilibrium which prevails, furnish an ample basis for variable peculiarities in the pathologic picture of hemihypertrophy.

There can be little doubt that in some instances there is more than a morphologic difference between the opposite sides of the body. There is a perceptible physiologic or energetic difference, which heightens the temperature of the affected side, accelerates the growth of the nails and hair, and even hastens the eruption of the teeth on that side. Thus in one instance the developmental disparity was so

great that there were eight teeth on the hypertrophic side with none erupted on the normal side.

This amazing discrepancy obliges us to recognize an energetic difference. It means that sometimes an individual may have two physiologic ages at the same time, one for each half of a developmentally asymmetric body. This is another striking indication of the two-ness of the hemihypertrophic individual.

### 5. ASYMMETRY AND MENTAL DEFECT

Hemihypertrophy, therefore, presents a startling though not altogether lawless deviation from the standard course of development. It is, after all, a quantitative deviation; and in a sense the real marvel is that it occurs so infrequently. The universal rule is a benign or negligible degree of asymmetry; but if the growth regulation breaks down beyond a critical limit of safety there may be abnormal consequences both physical and mental.

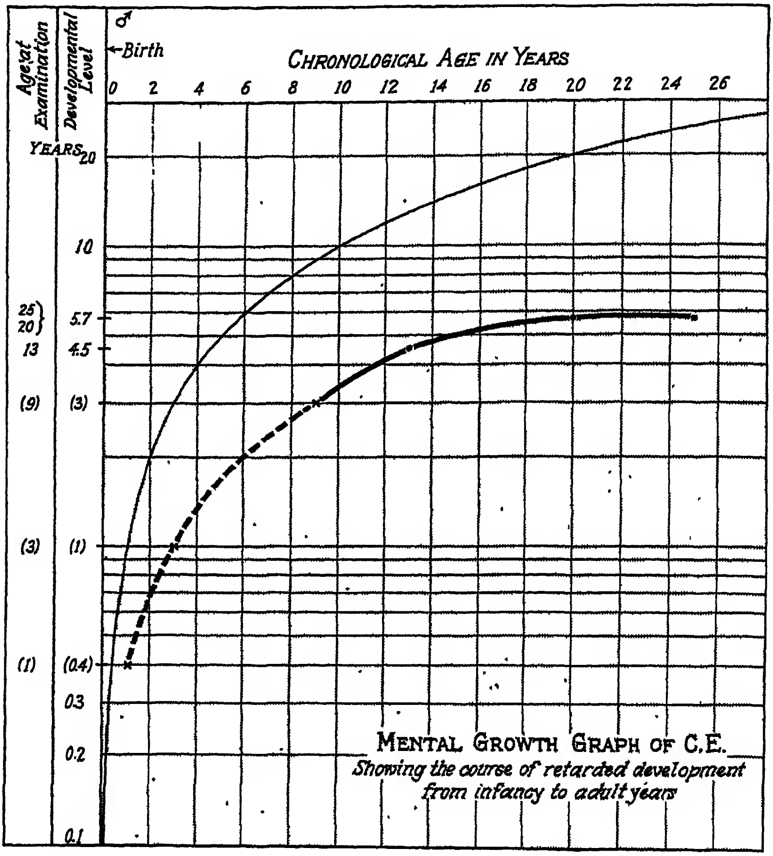
Anomalies and asymmetries of development are found with a high degree of frequency among the feeble-minded. Even in growth of stature they show significant departures from the normal. As Goddard found, "low grade idiots have not only a disturbed brain function, but their entire organism is disarranged and growth processes upset." In the imbecile the same is true but to a less extent. While mild asymmetry in structure is proverbial, pronounced asymmetry is certainly more characteristic of the mentally defective as a class. In a careful study, La Page measured the skull conformation in a series of 198 cases of feeble-mindedness and found lateral asymmetry in 158, or 80 per cent; and, what is very interesting in this connection, 122, or 80 per cent, of these cases, showed the hypertrophy to be on the right side. Is it not probable that there is some fundamental similarity

or even identity in the causes which produce pronounced cranial asymmetry and hemihypertrophy?

We have made an extensive canvass of the medical literature and found records of 53 cases of hemihypertrophy in this country and abroad (23, male; 30, female). Of the total number the right side was affected in 35, the left in 28. Skin complications were present in nearly half the cases. Mental subnormality was found in eight instances. This is a high percentage, considering the large number of cases in which a mental diagnosis was not made or not possible.

Whether there is anything peculiar or distinctive in the type of mental defect which accompanies hemihypertrophy, we cannot say. The youth, C. E., described above, presents a picture of balanced intellectual diminution. The degree and quality of his retardation have been very consistent over a period of 12 years. In spite of his deficiency he has shown attractive and creditable personality traits. He has been steady in employment, and has, with an intelligence quotient of 35, assisted in the support of the family. The detailed identity between the results of the psychological examinations made when he was 20 years and 25 years of age was remarkable. At both ages he was asked, How many fingers have you on the right hand? On the left hand? On both hands? At the age of 20 his answers were: seven, seven, eight. At the age of 25, his answers were: seven, seven, fourteen. At 20 he spelled and misspelled as follows: *cat, house, it, Mew Haven, Spelling, Arithnetic.* Five years later his orthography for these words was exactly the same, except that *it* was spelled *ta.* At 20 he could go to the store and return with one article. At 25 he could return with two or three. Beyond this we could discover no mental increment. The striking correspondence between the performances on the two examinations, incidentally,

serves as an example of decisive early completion of mental growth. The psychological plateau of maturity is very




**Growth Graph 25.**

evident. The Growth Graph of C. E. (Graph 25) gives a true picture of the course of mental growth from infancy to adulthood in a well-defined case of symmetrical retardation.

## 6. DEVELOPMENTAL HAZARDS OF TWINNING

There is another developmental aspect to the physiology of twinning, which deserves supplementary comment. We have discussed hemihypertrophy as a type of minimal twinning. It represents a failure of growth regulation in an early embryonic period, which brings about physical asymmetry, with abnormal consequences both physical and mental. The break in the control of symmetry appears to be at the basis of these consequences. If the twinning had been carried to a stage of balanced completion, no adverse results would have happened.

But there is some developmental hazard even in such completed twinning; and this deserves brief mention. The hazard arises out of the fact that during the prenatal developmental period one twin may gain a physiological ascendancy over the other. This is more likely to happen in monozygotic twins. The ascendancy may be so slight as to be almost negligible. In a minority of instances, however, the detriment to the injured twin may be serious. It is not suggested that twinning is in any sense abnormal. It occurs too frequently with no harmful results. Twins frequently show superior capacity; and there is abundant evidence that there is no reduction of vitality with maturity.

In the uterine period, however, there are certain disadvantages, which are the outcome of nutritive competition between two members of a pair of twins. In the case of fraternal (two-egg) twins there is competition for the placental surface which may result in inequalities. In the case of single-egg twins there is a similar competition, but a special hazard in the fact that there is an intercommunication between the placental vascular systems, constituting a third circulation. If this third circulation is balanced or sym-

metrical, then there is no injury to the welfare of either twin; if it is asymmetrical the one twin suffers; for a disproportion of arterial blood passes to the favored twin. Here is another kind of growth regulation, grosser than that which governs bilateral symmetry; but also fraught with important developmental consequences.

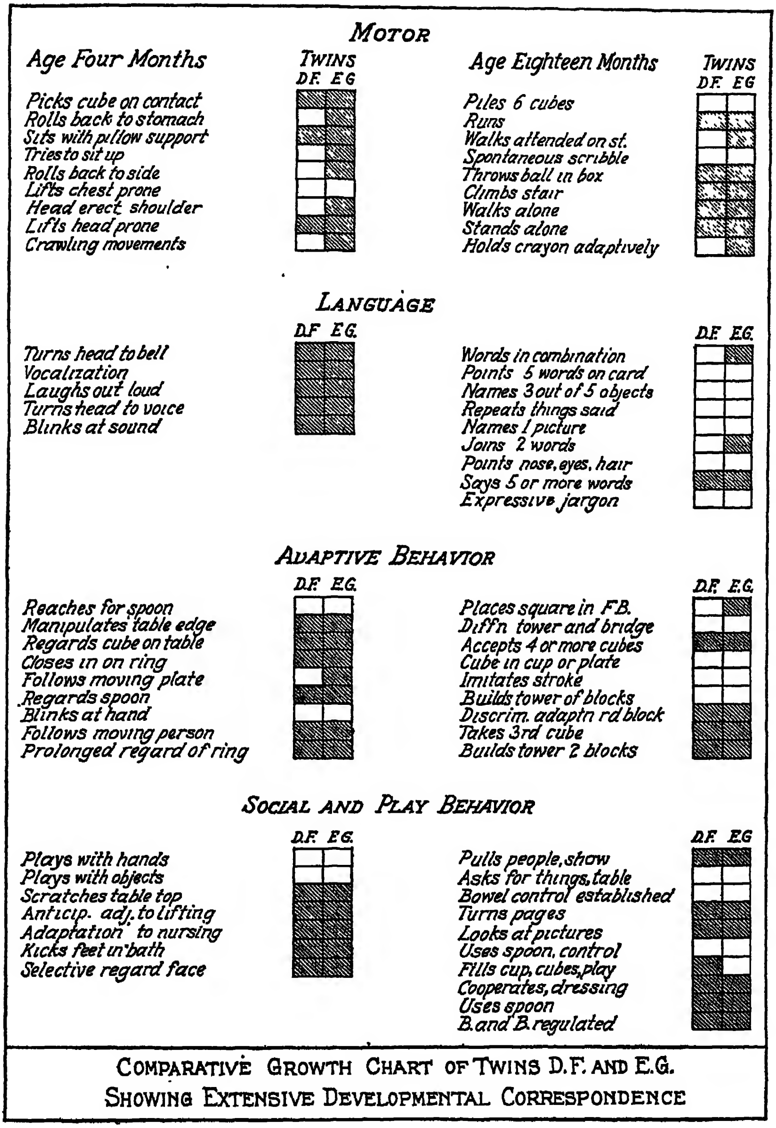
The details of the uterine interinfluence between twins need not concern us here.[1] Enough has been said to indicate the importance of these uterine conditions. They account for the fact that in no human group is the gamut of individual differences so great as it is among monozygotic twins. The differences range from gross disparity between a pair to virtually complete and balanced duplication.

### 7. DEVELOPMENTAL CORRESPONDENCE IN INFANT TWINS

It frequently happens that there is great inequality in the weight of newborn twins. This was true in the pair of twins, D. F. and E. G., whose development is graphed in the accompanying chart. Twin D. F. was born cyanotic and for a few months was not expected to live. He weighed only half as much as his favored brother at birth. When the twins were 4 months of age they were developmentally examined. D. F. was still a wizened little creature, physically inferior to his co-twin. In spite of this physical disparity, dating from birth, the developmental status of the two twins was very nearly equal. The comparative chart shows that with the exception of several motor items which were present only in the favored twin, there was correspondence.

D. F.'s motor weakness was marked. His head hung limp; he made no effort to sit up; he could not roll over like his

[1] Newman discusses the subject succinctly in his *The Physiology of Twinning*, Chicago, 1923, The University of Chicago Press. Pp. 230.




**Growth Graph 26.**

active brother. However, when the two infants were lying on their pillows, side by side, they did not differ markedly in their random, playful movements. They closed in on the dangling ring in almost identical manner. There was a striking degree of similarity in varied behavior items such as vocalization, laughing, reaction of hands to table edge, response to mother's voice, response to playful advance, blinking on sound stimulus, and failure to blink on visual stimulus. Such a thorough-going similarity was all the more impressive because of the physical disparity in the twins, and because the examiner was at the time under the belief that they were twins of the fraternal type.

We reëxamined these twins after an interval of 14 months, when they were just a year and a half of age. At that age there was still a perceptible physical inequality. D. F. was 31¼ inches tall and weighed 24½ pounds. This weight was 25 per cent less than that of E. G. D. F. was somewhat more timid and less stable than his brother; but otherwise there was again a high degree of similarity in behavior as shown by the developmental schedules. The twins were tested on thirty-five items from the 15 months to the 24 months level. D. F. scored 17 successes; E. G. scored the *same* seventeen successes and three aditional. The comparative psychograph gives a fair summary of the similarity of performance at the age of 18 months, which was foreshadowed by similarity of performance at 4 months.

These twins are undoubtedly of the monozygotic or identical type. Their similarities, structurally and functionally, are numerous and detailed. The high degree of correspondence in their mental growth careers has added significance because there has been such a marked physical disparity throughout their infancy.

In twins of fraternal type behavior differences may assert

Fig. 62. — Fraternal twins, Y and Z, age twenty-four weeks, who consistently exhibited contrastive emotional behavior as early as the age of six weeks. Z on the right is characteristically the more ready smiler.


Figs. 63, 64.—Overhead views of a pair of fraternal twins, Y and Z, at twenty weeks and twenty-eight weeks. In all three pictures (see Figure 62) Z shows a characteristic, greater initial responsiveness in smiling.

themselves early and with impressive consistency in view of the equality of environment. The accompanying photographs of Y. and Z. (Figs. 62–64) were taken when they were 20, 24, and 28 weeks of age. In all of them Z. shows a characteristic emotional expressiveness not evident in the graver face of Y. This personality difference will be commented on in Chapter XVII.

## 8. THE LAWFULNESS OF DEVELOPMENTAL PHYSIOLOGY

Although twinning is essentially a biological problem, it is germane even to the study of mental growth. All organic behavior emerges by imperceptible stages which trace back to the earliest embryonic period. All forms of growth regulation, therefore, operate directly and indirectly upon the final configuration, functional and structural, of the organism. In hemihypertrophy we are permitted a glimpse into the vista of events which converge back to the very beginnings of ontogenesis. It is made apparent that the actual products of growth regulation at that stage project themselves into the present and future.

The developmental correspondence in duplicate twins likewise bespeaks the nice and abiding precision of the early phases of growth regulation. Twins are relatively so common that we easily miss the genetic significance of the remarkable identities which monozygotic duplicates exhibit. These identities, countless in number, range from the patterns of the friction ridges on hand and foot to the conformation of the cartilages of the ear; from body build and biochemical characteristics to motor and mental traits. One twin may weigh twice as much as his duplicate co-twin, and yet the course of development as evidenced by behavior will be strikingly similar for the pair. This must be due to the fundamental parity of their nervous systems. One might

almost say that the whole scheme of developmental mechanics is designed to preserve the integrity of the nervous system in both children. Hence the parity of their mental maturation.

Twinning is an almost universal biological phenomenon. It underlies not only rare and illuminating anomalies like hemihypertrophy. It determines all bilateral symmetry. It is part of the intricate but lawful system of growth regulation which forms the subject matter of the new sciences of experimental embryology and developmental physiology.

# CHAPTER XV

# THE MENTAL GROWTH OF THE PREMATURE INFANT

## THE DEVELOPMENTAL CONSEQUENCES OF PREMATURE AND POSTMATURE BIRTH

There is a curiously interesting variability in the true age of the human infant at birth. This variation raises several searching queries in regard to the effect of time and of environment upon development. How does premature termination of uterine life alter the postnatal phases of life?

### I. THE PROBLEM OF PREMATURITY

The life of the child, for a season, may be more precarious than if he had been born at full term. But has he, perhaps, through premature birth, been granted some compensating stimulus in the struggle for existence? One or two months before the appointed time he lives in a world of sight, sound, and social ministrations. Will this confer upon him a precocious adjustment and carry him more hurriedly through his early infancy? Or is this precocious entrance into the world but an incident and will the nervous system proceed unperturbed in its growth, punctual to the usual program? One might formulate a host of specific questions relating to sense perception, conditioned reflexes, habit formation, and emotional life, — to inquire how far inheritance and inherent maturation determine the course of premature postnatal development.

Although prematurity in a sense constitutes almost an experimental situation, it is very difficult to construe the various factors which have been put to test, or even to define the postulates of the experiment. There is a great danger that we shall beg the very questions we would ask.

To what extent is prematurity abnormal? The physician has his answer, which stresses the extreme importance of the normal uterine environment. Ordinarily every added uterine day counts in the infant's favor. Is it possible, however, that Nature is shortening the period of pregnancy in the human species as an evolutionary advantage to the species? Accordingly the pre-term child is viable even though he may have completed but three-quarters of his allotted uterine life-period. To insure survival, there is an anticipatory augmentation of maturation of the behavior mechanisms, prior to seven months, if not a slowing down in the last two foetal months. Thus, the premature infant tends to approximate the normal neonate more fully than he logically should.

Surely the premature infant astounds us by the relative completeness of his repertoire of behavior. I recall, vividly, the expert manner in which such an infant rubbed his eye, which was suffering from a mild infection. How was it possible that he should bring that tiny fist to the place of irritation, direct it with such good aim, and churn with a rotary motion so skilful that it was amusing? Eye rubbing is a bit of behavior which would seem to have little value in the economy of uterine life; but possibly as one of innumerable prudential factors of safety, the complex mechanism for this adaptive response is in readiness a full month or more prior to the normal termination of the foetal period. Precocious maturation does not, then, necessarily take place as a result of premature birth; rather, to express the facts

paradoxically, precocious maturation is normal for the species and takes place prior to the time of premature birth as a protection against its hazards.

We are not, of course, trying to suggest that premature birth is "normal"; we are, however, attempting to rationalize the remarkable vitality which the premature infant may display in his precocious struggle for existence. It is significant that in this life struggle much will depend upon his behavior equipment. The physical factors of temperature, food, etc., are of great importance; but survival often hinges on the "behavior" capacities of the young creature. So consequential are these that refinement of the hygiene of the premature infant will come through a better understanding of his behavior limitations and requirements. Accordingly a knowledge of his behavior development must have medical as well as genetic import.

The present chapter will confine itself to the relatively normal aspects of the problem of prematurity and will simply inquire whether and how mental growth is affected by the precocious displacement of the birth date. This is a problem of developmental psychology. That the reader may avoid undue generalizations it is necessary to call brief attention to the different kinds and degrees of prematurity. Medical books must be consulted for more adequate details.[1]

The premature infant may be born without any pathological changes in his organs or tissues. This happens, for example, when he is delivered by Caesarian section; or when the foetal membranes have been prematurely ruptured or when labor has been prematurely occasioned by some phys-

[1] A convenient and comprehensive discussion will be found in Abt, I. A. *Pediatrics*, vol. I–VIII, Philadelphia, W. B. Saunders Co., 1923–26. See vol. II, pp. 437–524 for an article by Julius H. Hess on "Premature Infants."

ical shock, like a fall. In such traumatic prematurity the basic physical condition of the infant may be entirely normal.

In any given case the developmental outlook will be much influenced by the birth weight, the primary cause of the prematurity, the degree of injury or trauma suffered at birth, and of course the kind of care received in the early months Prematurity figures heavily in the causes of death of the newborn.

Ballantyne, putting the statistics together in round numbers, summarizes as follows: ". . . if one starts with 1200 conceptions, something like 200 of these are lost before pregnancy is ended and labor completed; and of the 1000 infants who come into the world alive 40 or 45 die in the first month, that is neonatally." A significant proportion of these neonatal deaths are conditioned by prematurity.

The birth weight of viable premature infants ranges from less than 1000 grams to about 2500 grams; the average weight for the full-term child being 3000 to 3500 grams. Mortality varies with the age. Of 56 born at the age of 6¼ foetal months, 80% died; of 110 born at the eighth foetal month, 35% died. These figures should not, however, obscure the fact that numerous children who are born prematurely not only survive but grow up without any obvious permanent handicap.

Dr. J. H. Hess, in summarizing his clinical experience, stated that "the majority of premature infants born after the thirty-second week into a proper environment, without birth injuries, undergo a normal mental development, progressing more slowly than the full-term infant during the first years. They average walking and talking about 6 months later and are somewhat slower in learning to coördinate, as evidenced by clumsiness and ease of falling, slight speech

defects, etc. All of these are, however, usually temporary manifestations and are followed by normal progress." It will be our purpose to examine the peculiar modality of the mental growth of the premature, particularly in infancy. If the healthy premature "outgrows" his handicap, let us inquire in what manner he does it.

## 2. THE ABSOLUTE ONTOGENETIC ZERO

This problem can be approached only through a critical consideration of age in relation to the maturation of the foetus. Ordinarily the age of any child is reckoned from his birthday. The statutory zero is placed at the very moment of his birth. If we cling to this convention, and it is a social convention which clearly defies biology, we should have to reckon the age of the foetus in minus months; and we should have to call the 2 months premature infant 3 months old when he is only one month old! Although one may ignore these refinements and escape these absurdities in dealing with older children, a nice regard for the precise genetic age of the premature infant is the first requirement for understanding his development. In fact, it becomes necessary to look for the absolute zero of age, and to reckon developmental values irrespective of the statutory zero. Birth is, after all, but a conventional nodal zero.

An absolute zero is always difficult to locate. The embryologist recognizes three well-defined stages in the early life history of the individual, the germinal, the embryonic, and the foetal. The germinal period begins with the fertilization of the ovum and lasts about one week, during which the zygote becomes a blastula, or a vesicle with an embryonic area consisting of ectoderm and endoderm. Then follows the stage of the embryo, which lasts about 6 weeks. During this period the cellular elements of the embryonic area

become arrayed into groups to form organs. Then follows the stage of the foetus extending from about the seventh week to the fortieth week. During the early part of this period the growing organism assumes a certain resemblance to that of a human being. At almost any time during the entire latter half of the period, premature infants who survive may be born. Not infrequently the stage of the foetus is continued beyond the fortieth week and the infant is then born "postmature." The normal, average duration of the total intra-uterine period is 280 days, or 10 lunar months, or 9 solar months. Pregnancy, however, may be prolonged a full month or even more. The zero hour of birth therefore shifts both up and down on the life cycle.

An absolute age zero would have a more stable placement. The beginning of the foetal period is possibly more uniform for the species and might be a more logical location for the zero; the stage of the embryo also marks a significant beginning. But it is the union of the two gametes, resulting in the zygote, which starts the developmental career of a new and unique individual. Amphymixis, fertilization, or conception therefore marks the true beginning of this individual. Then and there is the absolute zero on the age scale.

Philosophically it may be urged that even this is a proximate placement for the absolute genetic zero; because the germinal period extends back into the anteconceptional stage, when the gametes in the parents undergo a series of significant genetic stages preparatory to procreation. However, this antecedent period tapers back into remote ancestral stages and is linked with the history of the phylum. The conceptional zero is ontogenetic and sufficiently fundamental for the mathematics of the developmental age of the premature infant.

### 3. THE BEHAVIOR GROWTH OF THE FOETUS

Even this absolute zero lies temporally very close to the earliest behavior observed in the human embryo. Pflüger saw activity of the embryonic human heart in the third week of gestation. Strassman observed slow movements of the arms and legs of a human embryo at the age of 7 weeks in a case of extra-uterine pregnancy which came to his surgical attention. Minkowski, a Swiss neurologist, has made remarkable observations of early behavior in foetuses ranging from 2 to 5 months of age. These foetuses were studied immediately after removal by Caesarian section.

At 2 months reflex movements follow a light touch of the skin. These reflexes may irradiate over the whole body and involve both head and trunk.

As early as the third month, mouth movements through lowering and lifting of the chin occur on lip or tongue stimulation.

From the fourth to the fifth month, definite, patterned reflexes assert themselves. Thus, stimulating the foot evoked a reaction of the opposite hand, — a diagonal or trot reflex. Turning the head toward one side frequently caused movement in the arm of that side; moreover, the reflex was maintained in a tonic manner for some time by keeping the head in that position. These deep cervical reflexes are localized in the cervical spinal cord and suggest sensibility in the muscles and joints of the neck.

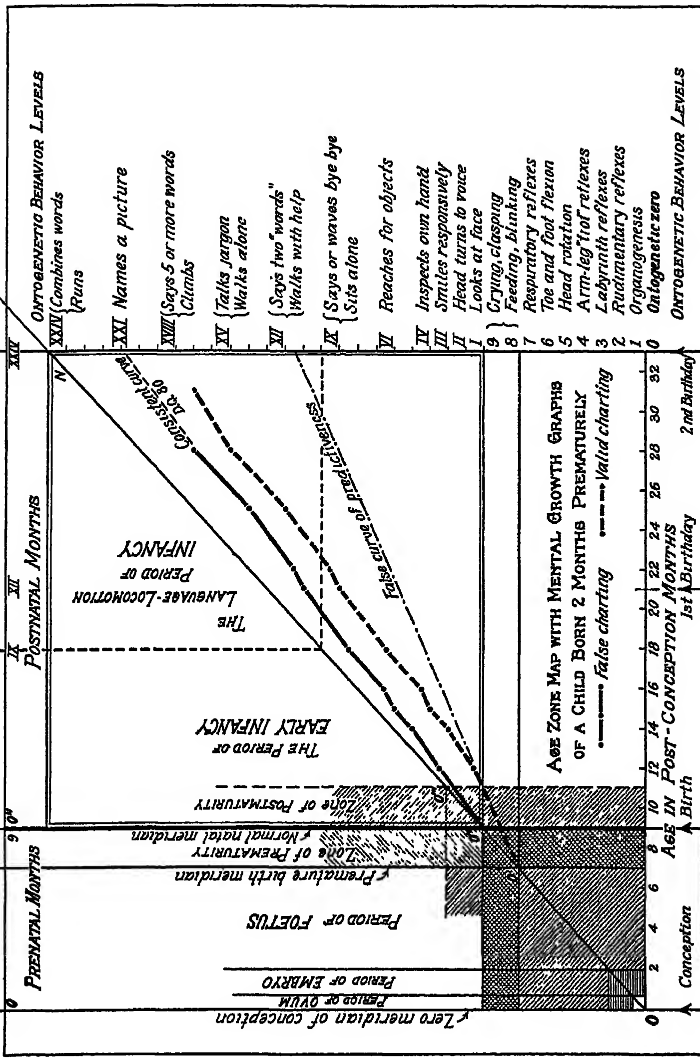
Remarkable are the reflexes of the labyrinth which also are present as early as the midpoint of the foetal period. These reflexes originate in the semicircular canals and consist typically in bilateral symmetrical movements of arms or legs, which occur when the position of the foetus is changed, as from a horizontal to a vertical position.

Thoracic movements, which have been regarded as respiratory in character, occur as early as the fifth month. Plantar flexion of the toes on brushing the sole of the foot was noted at the same age.

By the sixth month the neuromuscular equipment has advanced so far that children prematurely born in this month have some chance of survival. It is as though Nature hastened to bring the most vital functions for postnatal life to partial completion against this very contingency; whereas other abilities of the foetus bear some adaptive relation to his uterine needs. The labyrinth reflexes, for example, are not perfected so precociously for some purely morphological or architectural reason; but, as Minkowski suggests, because the foetus lives in a fluid medium and has functional use for just such an equilibrium function. The specific gravity of this medium is almost equal to that of the foetus. Therefore the foetus, almost without weight, is in a state of labile equilibrium, in which the reflexes of the labyrinth which maintain position or equilibrium play a greater part than after birth. One may even conjecture whether there is not an actual loss in this capacity before the full-term foetus is born.

## 4. THE COURSE OF GROWTH OF A PREMATURE INFANT

Diagramatically, we may then represent the early development of the individual as proceeding across a time-zone map, marked by meridians which pass through moments of time, in relation to events or environments. The zero meridian marks conception. At durational distances of 1 week, 7 weeks, 30 weeks, 40 weeks, 45 weeks, 80 weeks, are other meridians which more or less arbitrarily mark important stages in the developmental continuum. The successive zones (see Growth Graph 27) constituted by these




Growth Graph 27.

lines are in order: 1. The Germinal Zone; 2. The Embryonic Zone; 3. The Antenatal Foetal Zone; 4. The Zone of Prematurity; 5. The Neonatal Zone; 6. The Zone of Early Infancy; 7. The Zone of Later Infancy. The zone of prematurity (or its converse — the zone of postmaturity) will vary in width and will not appear at all in the map of the infant who is born exactly at term. The normal neonatal period is conventionally regarded as lasting about a month. During this period the infant exhibits many of the characteristics of the foetus. In the last quarter of the first year of postnatal life the distinctive human traits of articulate speech and the upright posture (and handedness) definitely appear. For this reason a meridian at the postnatal age of 9 months (conceptional age about 80 weeks) may be drawn to indicate the beginning of later infancy, when the child takes his own self-initiated, though directed, steps into the cultural circle. The normal natal meridian may be envisaged as lying temporally just midway between conception and later infancy.

How does the premature infant make his transit across the developmental map? Is his course in any way deflected by precocious birth? Our time-zone map is readily converted into a growth graph by plotting vertically the ascending parallels which indicate levels of maturity. The age scale zero and the maturity zero coincide. Vertical numerals indicate the developmental age levels in solar months. Arabic numerals on the base line indicate age, reckoned from the time of conception. Illustrative and normative items of behavior are listed vertically to make the schedule of behavior progress more concrete. It is evident that the "mental" growth course of an ideal median or normal individual would be represented by a straight diagonal; since such an individual would maintain a constant developmental

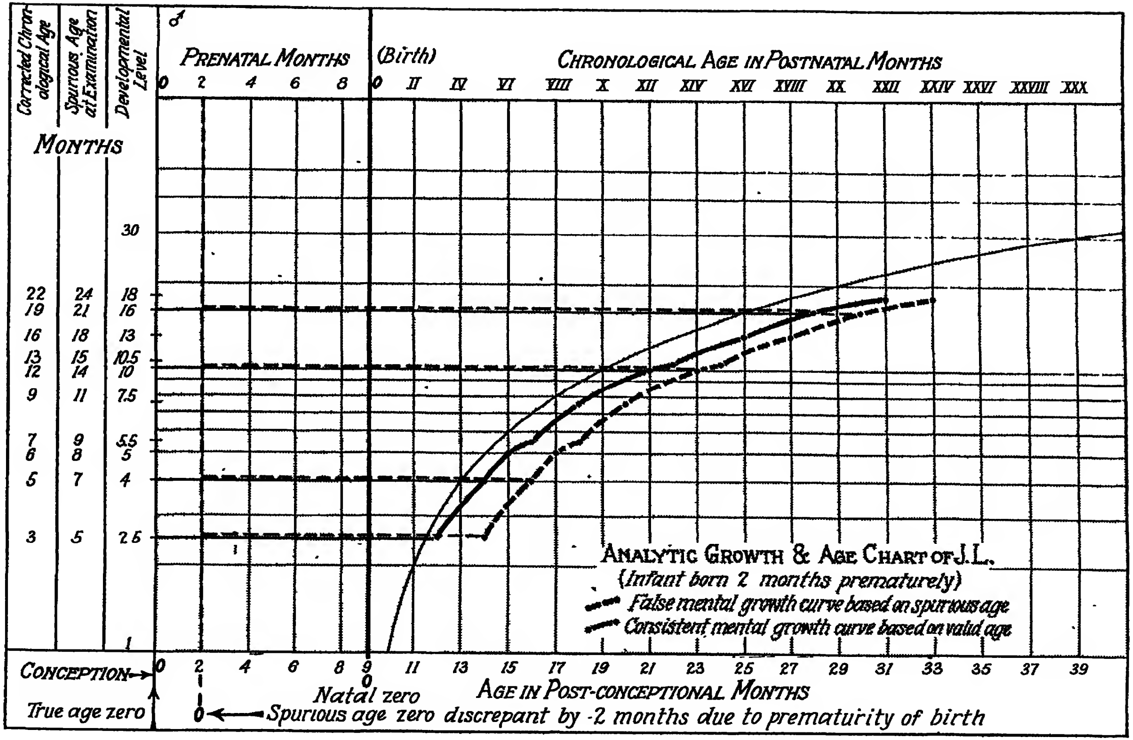
quotient of 100 along the whole pathway, whether one considers the total field of development, the normal post-natal field, or the larger premature postnatal field. This ideal diagonal is line O — O′ — O″ — N on the chart. (Growth Graph 27.)

To plot diagrammatically the course of development of a symmetrically subnormal child with an intelligence quotient of 80, we should assume a similar constancy of ratio of development, and following psychometric convention should reckon from the natal zero (O″ in the chart). This line is included in the graph as an additional line of reference to elucidate the effect of premature birth on the course of mental growth. It is evident that growth traverses three mergent fields, represented in the chart by three successive time-growth frames. These fields in the map must be considered both independently and comparatively if we wish to visualize the factor of distortion which prematurity introduces into the problem of developmental diagnosis and prediction.

With this map as a basis for charting, we shall attempt to express the developmental progress of J. L. an infant who was born two months prematurely and was repeatedly examined during the first two years of his life.

The results of these examinations are recapitulated in accompanying charts and table (see Growth Graphs 27, 28). It will be profitable to trace briefly some of the interesting problems which were raised while the growth of this boy was being followed. At the present writing he is nearly two years of age and we can see in fair perspective the general trend of his development. The following summarizes and interprets the findings at successive examinations.

*Examination 1* (Age 3 weeks). The child, J. L., has just been transferred from the obstetrical ward to the pediatric service. Though born fully 2 months prematurely he wears




Growth Graph 28.

"the ancient look" on his thin, weazened face which is covered with lanugo. His skin is soft and of pinkish hue. His fontanelles are soft but neither sunken nor bulging. His lungs are clear and heart sounds are of good quality and regular rhythm, rate 160. No ankle clonus found. Babinski reflex present. His weight is 1300 grams, which is 3 grams less than his birth weight.

*Examination 2* (Age 5 months). The first developmental rating was made when the child had attained a weight of 3440 grams and was ready for discharge from the hospital. He was then 5 months old. That is to say his statutory, postnatal chronological age was 5 months. His behavior maturity was much less than that.

To characterize his developmental status succinctly we may report selected behavior items, phrasing them in the present tense. J. L. looks at examiner regardfully. Fixates intently on dangling ring; does not definitely close in on the ring, but activity is increased while watching it. Visual fixation on the hand, but no typical 4 months hand play. Head wobbles markedly when he is lifted to shoulder. Does not manipulate or seize paper even when it is placed in hand. Turns head to bell, both right and left.

The general clinical impression of the behavior picture justifies a rating of less than 3 months or approximately 2.5 months. There is only one item which is rather inconsistent with this generalized rating, namely the response to the ringing of the bell. Further comment on this exception may be offered later.

If the foregoing developmental rating were accepted on its unqualified merit, it would yield a developmental quotient of 50 and necessitate a diagnosis of mental defect. No such diagnosis was made for reasons which will appear in the subsequent examinations.

*Examination 3* (Age 7 months). J. L. has made definite behavior gains since the previous examination. He now closes in definitely on the dangling ring. He tolerates the supported sitting position, though his head plunges forward from time to time. He kneads the table surface when held in lap. There is "exploratory" inspection of the room. He definitely regards a cube when it is placed on the table. On 10 successive trials, the span of visual fixation on the cube is uniformly about 3 seconds. He is socially alert, smiles responsively, coos mildly.

A certain quality of normality in the whole behavior picture restrains a diagnosis of mental defect, though the developmental level is only 4 months and the developmental quotient less than 60.

*Examination 4* (Age 8 months). Although it is only one month since the previous examination, he has made a perceptible gain which permits us to place his developmental level at approximately 5 months. He now definitely clasps the dangling ring. He grasps and manipulates a piece of paper when it is favorably presented. He regards a pellet placed on the table. His head is more erect, but still tends to plunge forward. His head-turning response to the ringing of a bell is very definite.

*Examination 5* (Age 9 months). Again J. L. has made a palpable gain though only a month has elapsed since the previous examination. He wears an alert expression (quite different from his neonatal "ancient look"); sits erect in his mother's lap and greets the examiner with a friendly smile. On several behavior items, increments can be concretely formulated. Direct grasping by one hand, which during the examination was mainly the right hand, has replaced the cruder closing in observed on the 8 months' examination. This reaching has not risen to the 6 months level, but there

is definite visual coöperation and there is some facility in prehension if objects are favorably and closely presented and if the child is on his back. He probably has not had much opportunity to exercise his capacity through play with toys. His head no longer tends to plunge forward as it did a month ago. His progression reactions in the prone position showed some advance. His hand to mouth reaction is not as dominating as it was on the previous examination. Vocalization of eagerness and pleasurable vocalization accompanying frolicsome play were in evidence. On the previous examination the child was almost altogether silent. The visual regard for the pellet also is more clearly defined. Interest in vanishing objects like a disappearing paper is more evident.

Our clinical comment made at the time of this examination may be quoted, as a summary of our impression to date: The postnatal almanac age of this child at the 4 last examinations was as follows: 5 months, 7 months, 8 months, 9 months. This age was reckoned from the date of his premature birth. The corrected chronological age for these successive examinations would be 3 months, 5 months, 6 months, and 7 months, if he was born 2 months prematurely as we assume. Reviewing all the ratings before us, we may say that the generalized developmental levels at the four successive examinations are: 2½ months, 4 months, 5 months, 5½ months. The developmental quotients on this basis are all of them approximately 80.

*Examinations 6, 7, 8, 9, 10* (Ages 11, 14, 15, 18, 21, 24 months). These examinations may be briefly reported together, because they revealed no new deviation in the trend of mental growth. On the contrary they showed a consistent tendency for the developmental quotient to remain at or very near the level of 80. At the postnatal

age of 11 months he picks up the pellet with a palmar scoop (an ability characteristic of 7 months maturity). At the age of 14 months he plucks it with precise pincerlike prehension, by opposing forefinger and thumb. At the age of 15 months he makes his first fugitive scribble marks with crayon. At 18 months he is beginning to walk with help and to say a few words. At 21 months he walks alone and uses expressive jargon. The general behavior picture indicates a level slightly above 15 months.

The findings for the entire series of developmental examinations are summarized in the adjoining table. This

DEVELOPMENTAL RATINGS OF J. L. BORN TWO MONTHS PREMATURELY

| Order of Examination | Postnatal Chronological Age (a) (in months) | Conceptional Age (b) (in months) | Developmental Age (c) | Corrected Chronological Age (d) | Genetic Age Level = $c + 9$ mo. (e) | Genetic Quotient $= \frac{e}{b}$ | Spurious Developmental Quotient $\frac{c}{a}$ | Corrected Development Quotient $\frac{c}{d}$ | Clinical Prediction BN, Borderline Normal |
|---|---|---|---|---|---|---|---|---|---|
| | mo. | mo | mo. | mo. | | | | | |
| 1 | 5 | 12 | 2.5 | 3 | 11.5 | 96 | 50 | 83 | ? |
| 2 | 7 | 14 | 4 | 5 | 13 | 93 | 57 | 80 | BN |
| 3 | 8 | 15 | 5 | 6 | 14 | 93 | 62 | 83 | BN |
| 4 | 9 | 16 | 5.5 | 7 | 14.5 | 91 | 61 | 80 | BN |
| 5 | 11 | 18 | 7.5 | 9 | 16.5 | 92 | 68 | 83 | BN |
| 6 | 14 | 21 | 10 | 12 | 19 | 90 | 71 | 83 | BN |
| 7 | 15 | 22 | 10.5 | 13 | 19.5 | 89 | 70 | 80 | BN |
| 8 | 18 | 25 | 13 | 16 | 22 | 88 | 72 | 81 | BN |
| 9 | 21 | 28 | 16 | 19 | 25 | 89 | 76 | 84 | BN |
| 10 | 24 | 31 | 18 | 22 | 27 | 87 | 75 | 82 | BN |
| x | 5 yr. | 5 yr. 7 mo. | 4 yr. | 4 yr. 10 mo. | 4.75 yr. | 85 | 80 | 83 | |

table brings out some interesting figures with reference to the significance of developmental age, and developmental quotient in the very young premature infant. These

quotients vary enormously, depending upon the method of calculation used. They do not, however, justify any doubt as to the validity of the concept of developmental age, even in the case of the premature child and during the period of his prematurity. Indeed the growth characteristics of the premature infant serve, if anything, to emphasize the fundamental importance and constancy of the age factor in the whole process of development. Small units of duration prove to be of great influence in determining the actual stage of maturity in the circumnatal part of the growth cycle. Prematurity does not in any marked way alter this influence. Precise mensuration of development in the period of prematurity would have to take into account the week as well as the month. Clinical estimates of the developmental status and developmental outlook of the premature infant must therefore discount carefully for the amount of prematurity.

### 5. THE RELATIVITY OF AGE IN THE PREMATURE

The premature infant has more than his share of ages; and it is for this reason that he presents a peculiarly interesting problem in the way of developmental diagnosis. This diversity of ages is, of course, due to the fact that he successfully defies the traditional absoluteness of the natal zero. He begins to have an age of his own the moment he is born, irrespective of the fact that in psychometry both chronological age and psychological age are assumed to be reckoned from the full-term natal zero. The consequence is that in determining the developmental status of the premature infant we must consider all the following possible ages and developmental ratios:

(*a*) *Postnatal Chronological Age.* This is statutory age reckoned from the actual moment of birth. It is, however,

a spurious age because it classifies the infant as being older than he really is.

(*b*) *Conceptional Age.* This is reckoned from the absolute zero of fertilization and is in no sense spurious. It is altogether independent of the time of birth and therefore does not vary with pre-term, full-term, and post-term infants.

(*c*) *Developmental Age.* This is expressed in months or years and conforms with the statistical convention of reckoning from the normal natal zero. The concept of developmental age, however, applies to the prenatal period as well and is appropriate for expressing the biologic age of the foetus.

(*d*) *Corrected Chronological Age.* This is the statutory, postnatal registry age of the premature infant minus the number of months or weeks of prematurity. It expresses the true postconceptional distance of the child from the normal natal zero.

(*e*) *Genetic Age Level.* This is an arbitrary fiction which assumes (gratuitously) that a constant of 9 solar months, equivalent to the gestation months, may be added to the postnatal developmental age, to extend the genetic age back to the time of conception.

Now what happens if we calculate developmental quotients or ratios on the basis of the above ages? Three kinds of quotients may be considered:

(*f*) *Genetic Quotient* $= \frac{e}{b}$. This quotient in a somewhat arbitrary way compounds both prenatal and postnatal ages, and reckons the developmental ratio from the time of conception. It yields fictitiously high values during early infancy, and furnishes no reliable basis for framing a developmental estimate or prognosis. As the child grows older this quotient is not seriously misleading.

(*g*) *Spurious Developmental Quotient* = $\frac{c}{a}$. This quotient is calculated in accordance with prevailing practice and is the ratio between developmental age and chronological age. It proves, however, to give fictitiously low values during early infancy. Like the preceding quotient it introduces a spurious error which becomes negligible only when the child approaches school age. This quotient in J. L. ranges from 50 to 75.

(*h*) *Corrected Developmental Quotient* = $\frac{c}{d}$. This quotient is reckoned from the normal natal zero; but the spurious chronological age is corrected by discounting the interval of prematurity. This brings the quotient into conformance with the prevailing method of expressing developmental status, and yields relative constant values for the whole period of infancy. These values for J. L. approximate 80.

## 6. THE STABLE SUBSTRATE OF MATURATION

The implications of this case, for clinical and developmental psychology, are extremely interesting. The discussion of the whole problem of prematurity might have been simplified if we had chosen for detailed study a child of full average intelligence. It happened, however, that we were dealing with a child who falls near the low limits of the average, both in physical and mental growth. This clinical deviation, however, serves to emphasize the issues which call for interpretation.

The broadest question which can be asked concerning the general problem of prematurity is this: Does prematurity, as such, produce a marked alteration in the course of mental growth? The broad answer is No. In the case of J. L. at least, the marked alterations have been apparent rather than

real. The fluctuations in the developmental quotients (*f* and *g*) are due to faulty methods of calculation or interpretation. A corrected ratio (*h*) which makes due allowance for the factor of duration, gives a consecutive series of nine relatively constant values. These values most satisfactorily rationalize the general mode of development which we have represented in the premature infant, J. L. So far as they have predictive import they forecast that at the statutory, chronological age of 5 years and 2 months this boy's development will be approximately at the 4 year level, with a corrected developmental quotient of 80. He will then really be only 5 years "old." Even at that comparatively advanced age, the failure to discount for his precocious entrance into the world would depress his quotient three points! Duration is a jealous mistress in the drama of development.

The broad conclusion which issues from this analysis suggests that the maturation of early behavior tends to follow an inherent genetic order irrespective of the time of birth. There appears to be a firm substrate of growth, not profoundly affected by precocious stimulation, which keeps the general configuration of the growth curve similar for full-term and pre-term infants. Or to state the fact more bluntly, the pre-term infant grows much like a foetus even though he is out of the womb.

It must be understood that we are comparing healthy infants of comparable quality in the original potentialities of growth. We have also limited ourselves to a consideration of the general tempo of mental growth. The finer, detailed behavior peculiarities which are incorporated into the growth complex of the premature infant, notwithstanding this underlying parity, can be adequately determined only by more precise methods of study. That such peculiarities

exist is very probable on theoretical as well as clinical grounds. Take the hearing reactions of J. L. as an illustration.

At the age of 5 months he made a surprisingly well-defined response to the bell-ringing test. A small hand bell was rung first near the right ear, then near the left ear, then again the right, etc. Each time he made a prompt, definite, adaptive head turning response. This reaction was, so to speak, out of keeping with the general level of his maturity which was less than 3 months. Decisive auditory head turning such as was displayed by J. L. is more characteristic of a 5 months level. Was this response, therefore, an accidental "anticipation" in the sense of Koffka; or was it an example of true induced prematuration or precocious conditioning due to prematurity of birth?

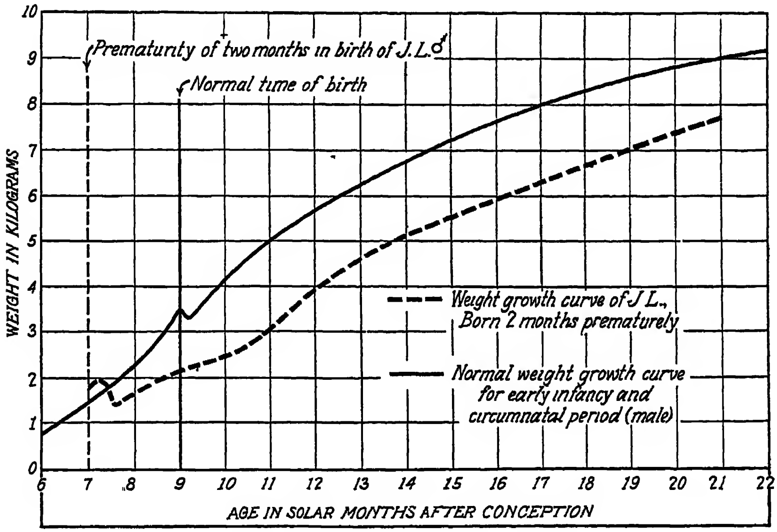
A complete answer to this question would be very illuminating. Hearing, like seeing, is a complicated function, and it grows. It takes time to develop. Tudor-Hart and Hetzer discovered that there was a most rapid increase in efficiency in hearing in the first 4 weeks. Judging by reaction to noises, sounds and the human voice, it was found that the 4 to 7 day child heard one and a half times as well as the 0 to 3 day child; and the 2 months old child heard about two and a half times as well. There was not much improvement after the second month. Now it is possible that there is a rudimentary stage of hearing development which is appropriate to the last end of the foetal period, which cannot be short circuited by the premature child. He will therefore not hear as well, as much or as often as a normal neonate. On the other hand, if we must grant that his hearing mechanisms are at the ordinary neonatal stage of completeness, there will be a palpable acceleration of conditioned behavior in the auditory sphere.

There is no doubt, in our mind, that the premature infant is a habit-forming creature even during the period of his prematurity. He is not altogether impervious to the impact of light and sound and to the physical ministrations of the nurse. On the basis of this susceptibility to recurrent impressions, very elementary patterns of behavior must take shape; so that he acquires certain "expectations" or "trends of reaction" which could scarcely have been formed within the isolation of the uterus. Whether audition, as such, whether even oculomotor control is hastened by precocious release from uterine protection, is not clear. But conditioned modes of listening or of eye-following, and selective attention to the human face and to the human voice may well be somewhat advanced on the developmental schedule of the premature infant. In the habit-forming field of personal-social behavior, expressed in the personality, there may be skewing or discrepancy in his apparent favor. Such a personality discrepancy may assert itself with temporary vividness when a newborn full-term infant is compared with a pre-term infant who has had two months of "experience" in a socialized environment. All things considered, however, the extrinsic conditioning factors seem to be of secondary importance in determining the mental growth of the premature child. The substrate of maturation in cases without pathological complications is relatively secure. This is a developmental safeguard for the prematurely born.

## 7. THE PHYSICAL GROWTH OF THE PREMATURE

The physical growth chart of J. L. is inserted. It happens to bear a broad resemblance to his mental growth curve. His "subnormality" in weight is of incidental and secondary importance here; but the tendency of the early part of his weight curve to cling to the foetal slope is significant.

In the present study we have attempted to bring the mental growth of the premature infant and of the full-term infant into quantitative comparison. Scammon has made an interesting comparison in the field of physical growth in a study "On the Weight Increments of Premature Infants as Compared with Those of Foetuses of the Same Gestation



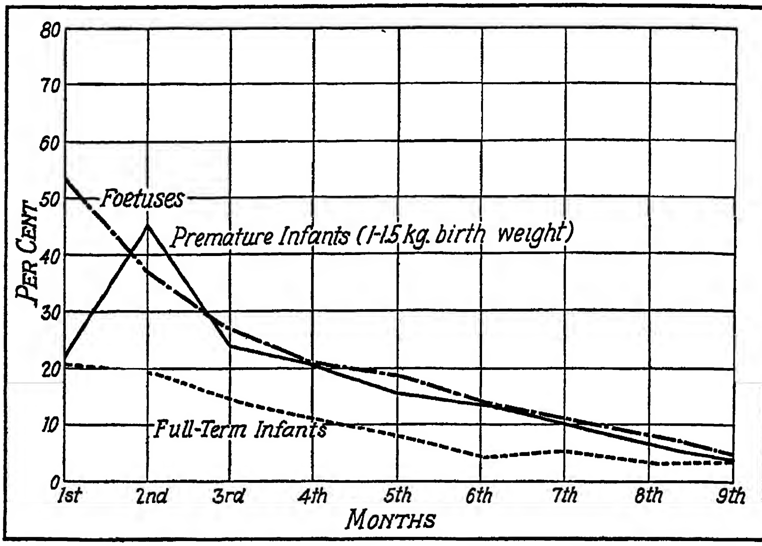

**Growth Graph 29.**

Age and Those of Full-Term Children."[1] His results are summarized in the accompanying graph. "These results indicate that premature children, after a short period of retarded growth incident to the adjustment to the extra-uterine environment, tend to regain the foetal rate of growth and to follow this course of growth until some time in the latter part of the first year, when the rates of foetal and post-natal growth approximate one another. In other words, the

[1] *Proceedings for Experimental Biology and Medicine*, 1921, XIX, pp. 133–136.

growth tendency of prematures is in general that of foetuses of the same size and age rather than that of full-term children." (See Growth Graph 30).

Once more the evidence points to the primary importance of the intraorganic factors of maturation as opposed to



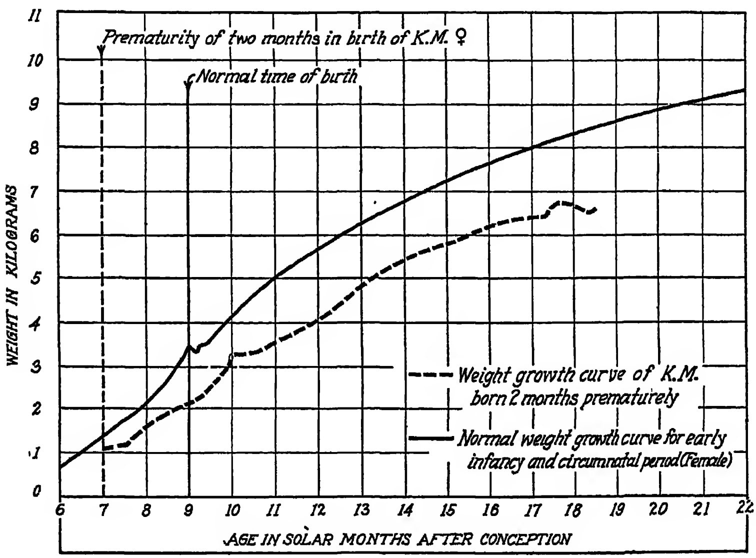

**Growth Graph 30.**

**Graph showing monthly percentage increments in weight of premature infants ranging from 1.0 to 1.5 kilograms in birth weight. The solid line represents the rate of increment of the premature children the first 9 months after birth. The upper broken line represents the calculated rate of increment of the foetus of the same size and age as the prematures. The lower broken line represents the rate of increment of full term children (Scammon). This graph may be compared with the growth graphs of J. L. and K. M.**

external factors of even exceptional environment. For what could be more exceptional than postnatal conditions for a prenatal organism?

The maturation of the central nervous system is perhaps

least affected by the condition of prematurity. The head of the premature infant continues to grow in size at a relatively normal rate, even when his general bodily development is distinctly subnormal. Indeed a disproportionately large head is a distinguishing characteristic of the premature infant during the first three quarters of the first year. This

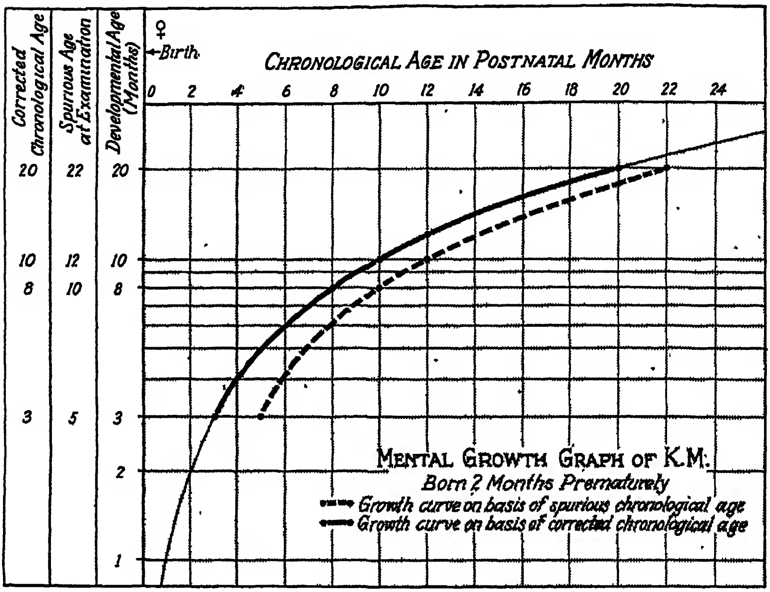



**Growth Graph 31.**

disproportionate size, in uncomplicated cases, is due neither to hydrocephalus nor rickets, but results from the fact that the substance of the brain undergoes normal increase even when the rest of the body grows slowly. Here is another indication of the preferential growth of the nervous system, so frequently referred to in this volume. This preferential factor makes for normality of mental growth in the premature.

## 8. A CASE OF TRAUMATIC PREMATURITY

This case presents an interesting supplement to the case of J. L. It is that of an attractive young child, K. M., whose development has been followed for a period of almost two




Growth Graph 32.

years. It is highly probable that her potential development at conception was entirely normal. It will be profitable to inquire to what extent this normal potentiality has been realized in spite of her prematurity of birth, severe rickets, secondary anaemia of the alimentary type, and prolonged excessive subnormality of weight, to say nothing of epidermolysis bullosa, which happened to be added as a complication. (This is a hereditary peculiarity of the skin which is

evidenced in blisters that readily form on mechanical irritation.)

The prematurity was of the nonpathological type — a traumatic prematurity which resulted from an accidental fall on the part of the mother. The mother was taken to a hospital and there was spontaneous labor, without complications. After two days a well-formed infant of 1115 grams weight was born. This birth was at least two months premature. There was difficulty with regard to feeding regulation. The accompanying graphs summarize the course of physical growth and mental growth (Growth Graphs 31, 32). It will be seen that the child was four months of age before she attained an ordinary birth weight, 7 lbs. 5 oz. When she was a year old her weight was 15 lbs.

K. M. — Born 2 Months Premature

| Order of Examination | Postnatal Chronological Age (a) (in months) | Conceptional Age (b) (in months) | Developmental Age (c) (in months) | Corrected Chronological Age (d) (in months) | Spurious Developmental Quotient $\frac{c}{a}$ | Corrected Developmental Quotient $\frac{c}{d}$ | Clinical Prediction ? = Deferred; N = Normal; A = Average |
|---|---|---|---|---|---|---|---|
| 1 | 5 | 12 | 3 | 3 | 60 | 100 | ? (N.) |
| 2 | 10 | 17 | 8 | 8 | 80 | 100 | N. A. |
| 3 | 12 | 19 | 10 | 10 | 83 | 100 | N. A. |
| 4 | 22 | 29 | 18+ | 20 | 86 | 95 | N. A. |

Four developmental examinations were made at the following postnatal chronological ages, — 5 months, 10 months, 12 months, and 22 months. The findings are summarized in the foregoing table. These examinations were so spaced that they will furnish an interesting parallel

to the examinations of J. L. Only a few brief comments will be made concerning these examinations. At the age of 5 months, when this child weighed only 8¼ lbs., she presented a definite picture of immaturity. Neither in vigor nor capacity did she approximate either a five months or even a four months old infant. She followed moving persons with the eyes, but there was no well-defined exploratory inspection of the environment. She was, however, inspecting her hand for brief intervals at this time. She was beyond the two months level of maturity. Her status may be described as approximately at the three months level. The chief discrepant item, interestingly enough, was the same one noted in the case of J. L. at this same chronological age. In spite of her general immaturity she turned her head definitely to the ringing of a bell on either side.

On the second examination she was 10 months of age. In the interval her weight increased to 13 lbs. 12 oz. Her developmental rating indicated that she was consistently at the eight months level of maturity. Because of our special interest in this child, on account of the problem of diagnosis and prognosis presented, we sought out a normal full-term infant N. F. T. whose actual age was eight months and brought this infant into systematic comparison with K. M. The results of this comparison were analyzed by a developmental schedule of 35 items. It was found that from the standpoint of performance the ratings were highly similar, even though N. F. T. weighed over two times as much as K. M. K. M.'s actual chronological age, if we take the time of conception into account, was not 10 months, but 8 months. The high degree of comparability between the full-term and the pre-term infant suggests that the latter had, and to a considerable degree, realized, a normal potentiality of development. Her developmental quotient

based on ascertained developmental age, and corrected chronological age, was approximately 100.

A third examination was made at the age of twelve months and yielded a developmental rating of ten months. She was then able to sit up in bed steadily for fairly long periods, but suffered from severe rickets.

It was our good fortune to be able to make another examination of this child at the chronological age of twenty-two months (corrected chronological age twenty months). At that time she weighed 22¼ lbs. Her height was 79.5 cm. We were gratified to find that she was fulfilling the prediction of relatively normal development. Her rating was definitely above eighteen months and her developmental quotient no lower than 95.

In summary, this growth study portrays an infant who at the age of five months presented a most unpromising picture, both with regard to her behavior capacity and with regard to her physical development. By ordinary age standards she was extremely subnormal in both directions. This aspect of subnormality, however, was much ameliorated by the fact that she was two months premature. Taking this factor of prematurity into account, she presented even then a relatively normal developmental ratio although with a dynamic reduction of vigor and energy. Now that she is better nourished even this dynamic reduction is disappearing. It is highly significant that such a degree of physical subnormality, even when complicated with the handicap of prematurity, is incompetent in itself to produce a drastic permanent impairment of development.

### 9. A GROWTH STUDY OF A POSTMATURE INFANT

The problem of postmaturity is in a sense the very antithesis of the problem of prematurity. It will be well, there-

fore, to take a supplementary glance at some of the complications which deferred birth may introduce into the story of development.

Premature birth, as we have seen, does not, in itself, seriously disrupt the developmental advance. But what happens if the growing organism at the appointed time of birth is kept from the manifold physical and social stimuli which normally pour down upon the newborn? This kind of deprivation occurs in all those instances where nature prolongs the period of pregnancy much beyond the ordinary span of 280 days. The developmental circumstances of the postmature infant are in strange contrast to those of the premature. Whereas the latter is precociously plunged into the manifoldness of the world, the postmature lingers in the vegetative shelter of prenatal life. How do these restrictions affect *his* developmental advance?

The mere formulation of the problem raises extremely interesting questions in the field of psycho-biology. It is evident that in postmaturity nature is supplying us with an almost experimental opportunity to study the phenomenon of maturation.

Postmaturity does not happen with the same frequency[1] as prematurity, but it may reach almost the same relative degree. Apparently well-developed children may be born as early as the 240th day, and as late as the 320th day after the last menstrual period. In very exceptional cases the pregnancy may last as long as 336 days.[1] This means that the full range of variation in the actual time of birth of viable infants is approximately four months. The effect of a month of postmaturity on the early development of the infant becomes a question with important scientific implications.

We have had opportunity to observe one infant, a girl,

[1] Williams, J. Whitredge; *Obstetrics*. New York, Appleton, 1926. Pp. 1076.

L. N., in whom the factor of postmaturity must be definitely reckoned with. Eight developmental examinations were made of this child between the ages of three months and twenty-eight months inclusive. She first came to our attention as a feeding problem and we did not consider the question of her postmaturity until late in the series of examinations.

From the beginning she has presented an indubitable picture of general acceleration of development. That her birth was definitely delayed is very probable from the history of her intelligent mother. Birth was anticipated fully two months before its actual occurrence. It is more probable, however, that the period of postmaturity was one instead of two months. In the accompanying table the developmental ratings are interpreted on the basis both of one month and of two months of postmaturity in order to show the variability in ages and developmental ratios.

The influence of postmaturity on the dynamics of development can be best determined only by careful normative studies in the first few months of life. Our acquaintance with L. N. did not begin until she was three months of age. In spite of the incompleteness of our data, the course of her development has been such as to bring into relief some interesting aspects of the problem of postmaturity. The developmental ratings made at eight successive examinations will be presented in a table after brief discussion.

At the age of three months L. N. made an excellent showing on the four months developmental schedule. Her eye-hand coördinations were well advanced; hand inspection had been noted. Her reactions to objects associated with dressing and bath were sufficiently advanced to simulate reaching. She had laughed aloud. (She is reported to have cried with tears from birth, though we could not get verifi-

cation of this interesting item.) Her mother had by conditioning methods trained her to regularity in bowel action. L. N., at the age of three months, showed a conditioned type of behavior in this situation, most unusual for her age. Although a precise rating of her general maturity level at this age was impossible, there can be no doubt that her level was significantly advanced.

At the age of four months a similar advance beyond chronological age was noted. The most remarkable feature of the general behavior picture was an extraordinarily persistent and vigorous resistance to breast feeding. She would stiffen, strike out with arms, push and alternately clench her lips and cry. This behavior was continued with marked perseverance. (It later yielded to control and was apparently a negative protective reaction to overfeeding.)

A third examination was made at the age of eight months. At this time a somewhat closer estimate of developmental level could be made. This level was clearly about two months in advance of postnatal chronological age — a well-defined and uncommon discrepancy.

At the age of nine months L. N. was showing an unusual degree of investigatory activity. Although she could not walk unassisted she was cruising about with ease in her nursery toddler and manifesting much curiosity. Her behavior picture compared very fully with that of an average twelve months child.

When L. N., herself, was twelve months old she rated near the fifteen months level. At the close of the developmental examination which lasted nearly an hour she was brought to the observation compartment. Her behavior under these conditions is briefly indicated in the following record:

L. N. crawled up the stairs leading to the compartment with alacrity, and addressed herself at once to the upright

reaction screen on the opposite side of which a small bell, rods, and cymbal were hanging. Her attention to the screen and the compartment was selective for details. She played at once with the rods that hung from the ceiling. She pulled the rake through the grating with much vigor. She pulled the rope through. She played with the sliding hooks on the transverse bars. The intensity and quality of her attention were good, but the periods of fixation were very short, which gave the impression of high pressure activity. (The mother is under the impression that the child is extremely nervous, but this impression is not justified by the quality of the behavior. The attention itself does not have the characteristics of shallow instability or excessive distractibility. It has rather the character of rapid machine-gun fire.)

The general character of her reactions is much influenced by the fact that she is under a strong locomotive drive. She remains in a seated position only for a short period. She then begins to walk, to crawl, to toddle, to climb. When placed on the floor she repeatedly resumes a standing position and tries to climb bodily over the screen. When the screen was raised to a horizontal position, 2½ feet from the floor, she still tried to climb over it. When given the freedom of the compartment she tried to climb over the gate. At no time did she display any perception of the implemental value of a string or a stick or even of the gate which swung on its hinges. She liked to play with the gate, swinging it back and forth, and also enjoyed playing with the trap door; but she did not ever crawl through the opening left by the gate ajar in any purposive manner. Several times when she wished to go to her mother, who was stationed near the entrance of the compartment, she might have done so simply by stooping down and crawling under the overhead screen. Instead of this she made a vigorous

struggle to climb bodily over the screen, that is, to scale it. There was no utilization of the roundabout method of securing an object, but she was able to thrust her hand through the grating to secure something on the other side. This whole behavior picture is definitely in advance of any ordinary twelve months reaction which we have seen in the observation compartment.

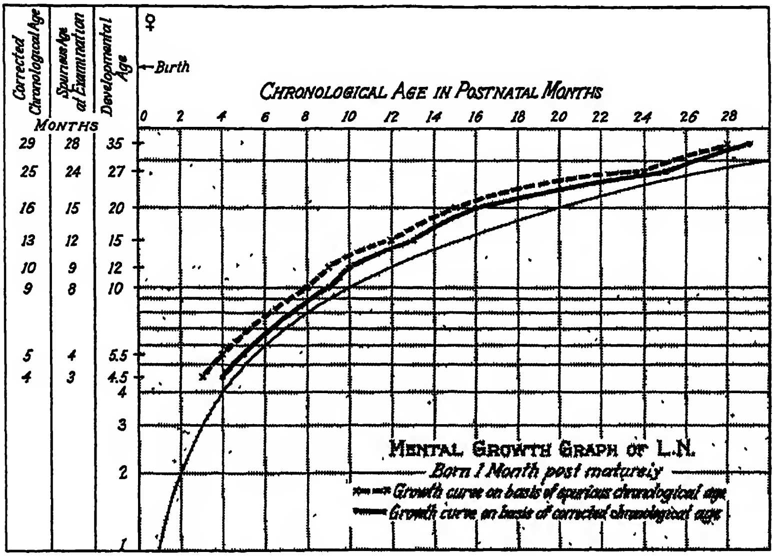
L. N. Born 1 or 2 Months Postmature

| Order of Examination | Postnatal Chronological Age (a) (in months) | Conceptional Age (b) (in months) | Developmental Age (c) (in months) | Chronological Age (d) Corrected for 1 mo postmaturity | Chronological Age (d) Corrected for 2 mos postmaturity | Spurious Developmental Quotient $\frac{c}{a}$ | Corrected Developmental Quotient $\frac{c}{d}$ Corrected for 1 mo. postmaturity | Developmental Quotient $\frac{c}{d}$ Corrected for 2 mos. postmaturity |
|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 13 | 4+ | 4 | 5 | 150 | 115 | 90 |
| 2 | 4 | 14 | 5+ | 5 | 6 | 135 | 110 | 90 |
| 3 | 8 | 18 | 10 | 9 | 10 | 125 | 110 | 100 |
| 4 | 9 | 19 | 12− | 10 | 11 | 135 | 115 | 100 |
| 5 | 12 | 22 | 15 | 13 | 14 | 125 | 115 | 110 |
| 6 | 15 | 25 | 18+ | 16 | 17 | 130 | 120 | 115 |
| 7 | 24 | 34 | 24+ | 25 | 26 | 115 | 110 | 100 |
| 8 | 28 | 38 | 36− | 29 | 30 | 125 | 120 | 115 |

Three additional examinations were made of this child, the last at the age of twenty-eight months, when she rated near the three year level. The ratings and developmental ratios for all the examinations are assembled in the accompanying table and graph (Growth Graph 33). The table is similar to the one used for the premature infants and reveals a corresponding sensitiveness of the developmental quotient to irregularities in the time of birth.

The spurious developmental quotient which is derived from the fictitious chronological juvenility of the postmature infant in the early months tends to be excessively

high; just as in the premature it tends to be too low. A valid quotient can be determined only by making adequate correction in the statutory chronological age. In the present case, a correction of one month (rather than two) for postmaturity gives the most consistent series of developmental




**Growth Graph 33.**

quotients. L. N. is accelerated in her development, but probably not to the degree suggested by the unadjusted developmental ratios.

The growth careers of the postmature as well as the premature infant strengthen the suggestion that inherent maturational factors determine the tempo of development. These factors may well be so organically intrenched in the constitution of foetus and infant that they assert their sway whether the chronological moment of birth is precocious or postponed.

# PART THREE

## THE SIGNIFICANCE OF INFANCY

# CHAPTER XVI

# THE PREËMINENCE OF HUMAN INFANCY

## Distinctive Characters of Human as Compared with Infrahuman Infancy

Few things in nature have a more universal appeal than animals in their infancy. The helplessness, the immaturity, and the sportiveness of undeveloped creatures awaken curious compounds of interest, sympathy, and amusement. A suggestion of kinship may even be dimly aroused, for in the very fact of infancy man recognizes a condition which he shares with all but the lowest animals.

In the lithographic days, Currier and Ives published a print entitled "First Steps." In picturesque juxtaposition it portrays a nestling about to leave its nest; a puppy taking his first wobbly stroll, and a young child toddling down the garden path. In each instance a directive parent is hovering near. The human mother naturally dominates the picture, but she does not fill it completely. In its quaint way this household print sums up acceptably the more general meaning of infancy.

An increased interest in the origin of man has given new spice to the whole subject of animal behavior. The psychology of infancy in animals assumes significance because it may shed light on human development; and it inevitably raises questions of a comparative nature.

The ancient Greek philosopher, Protagoras, propounded the doctrine of *homo mensura*. He held that man is the

measure of all things and that things have meaning only in terms of human interest. Scientifically, we can scarcely avoid inquiry and speculation concerning the infrahuman mind, and all interpretation will inevitably be in terms of our own human mind. No one can escape the doctrine of Protagoras, not even the extremist, who would put man in one order of nature and animals in an altogether different order, accomplishes an escape.

To what extent the behavior of animals should be construed in human terms is, however, a problem for very cautious consideration. If there are latent or active prejudices to be overcome, this is more reason for establishing psychological parallelisms between human and infrahuman infant with great regard to the descriptive implications. It is our deliberate purpose in this chapter to look for the distinctive characters of human infancy and to point out errors which are latent in the overemphasis of the similarities between infantile and infrahuman behavior.

## I. THE GENERAL NATURE OF INFANCY

In a philosophical vein one might be tempted to ask, Why should so many creatures in the animal kingdom be subject to the callow limitations of infancy at all, when Athena was able to spring full panoplied from the brow of Zeus? A survey of the whole range of life, however, suggests that nature is favoring this very "limitation." It is the simplest animals like the one-celled paramecium which have no infancy, whereas among the primates infancy is prolonged. It takes time to grow, and infancy is that time. Athena, after all, is a myth; and the doctrine of evolution makes it almost unthinkable that any true event of creation could be altogether instantaneous.

Infancy is a period of formative immaturity, which tends

to lengthen (and to involve more deeply one or both parents) as the organism becomes more complex. Although infancy itself denotes incompleteness and imperfection, there is an evolutionary premium upon it, with the paradoxical result that infancy is most prolonged and intensified in the species which stand highest in the life scale. The precocious bird is biologically (and hence psychologically) the most primitive.

The study of infancy in its broadest sense must therefore be a comparative science.[1] The more general laws of development in the very nature of things will be applicable to all vertebrates not excluding either fish or man. In spite of the bewildering diversity of the behavior traits of the young of widely varying species, it is not improbable that there are certain orders of emergence and sequences of pattern which are common to all. It is conceivable moreover that certain pervading correspondences may even yield to quantitative and qualitative gradations when the infancies of a large array of species are systematically studied from the standpoint of developmental economy.

Numerous aspects of infancy can be studied comparatively with respect to duration or age. Gestation, birth, longevity, size, and the maturation of abilities vary significantly for different species in their time relations. These secular characteristics in turn may be found to vary with biochemical differences. But the biochemical identities between species also are impressive. J. Huxley has pointed out that if one wishes to demonstrate the effect of thyroid on the develop-

[1] No comparative treatise on infancy has, to our knowledge, been written. Mention should, however, be made of two books by British authors to whom I am indebted: Pycraft, W. P., *The Infancy of Animals*. New York, 1913, Henry Holt and Company. Pp. 272. Mitchell, P. Chalmers, *The Childhood of Animals*. New York, 1912, Frederick A. Stokes Company. Pp. 269. Mention should also be made of Mills, Wesley, *The Nature and Development of Animal Intelligence*, which has a section on the psychic development of young animals. London, 1898, Unwin. Pp. 307.

ment of a tadpole, one need not trouble to secure the thyroid substance from a frog or even from an amphibian. The thyroid substance of an ox or a sheep will do just as well. For that matter the thyroid of the sheep has often been used to further the development of the human infant.

## 2. INFANCY IN THE LOWER ANIMALS

The forms and manifestations of infancy among animals are so diverse as to make sweeping generalizations very hazardous. In some species the infant bears no outward resemblance to the adult, and growing up is a process of metamorphosis in which behavior as well as structure undergo startling transformation. The adult then is a revised edition of the larva (the infant) but so radically revised as to appear like a new volume by a new author. The familiar frog is a sufficiently striking example. In the tadpole chapter of its life history it is essentially a fish, a gill-breather; in the completely revised phase it is a terrestrial creature, a lung and skin breather. Reptiles on the other hand are virtually unabridged, though miniature, editions of adults as soon as they are hatched.

In insects, the processes of early transformation are so complicated that almost the whole span of the life cycle is given over to what may be called the period of infancy. The larva of the dragonfly may spend a year, or it is said even three years, as a water dweller, after which it climbs a grass or reed, and with almost kaleidoscopic abruptness takes wing for a brief career in the air. However there are insects in which there is no sudden metamorphosis. In the locust, for example, "the period of youth is occupied by a series of moults in which the successive larvae slowly assume the characters of the adult, the wings gradually growing longer." Likewise marine crustacea grow by moults; but

since their skin is hard and shell-like they cannot change in a slow continuous manner. The changes in the common shore crab, for example, proceed "by jumps," and one observer collected a series of over a dozen cast-off shells, from one individual, in a period of three years, and this individual was still an infant when he died.

Since there is only one "species" of man, in contrast to a few hundred thousand of species of insects, we may well grant at least this passing reference to the characteristics of their infancy. Some of the provisions which the higher social insects make for the care and welfare of their young are amazingly advanced, not to say "human" in similitude.

To a considerable extent this statement applies to birds as well. This is particularly true of the highest types of birds, which include the songsters and perching birds. Among them the young are hatched quite naked and helpless. This means a prolonged period of brood-care, in which the equivalent of human problems of child guidance are met and solved to a surprising degree. These problems include such fundamentals as feeding the young, sheltering and warming them, sanitation, warning and protection, training and discipline. We may thank the statistical ornithologist, who observed a nest of nestlings for seventeen hours, and in that time counted the number of journeys which the assiduous pair of parents (blue titmice) made to the nest bringing foraged food to the young. The number was 475.

Contrasting with birds of this helpless and helping type, are the much larger group of "precocious" broods who burst into the world clad in down and active enough to feed themselves with little or no parental guidance. In one species, the megapode (moundbuilder), this precocity has been developed to such an extreme that the "nestling" stage is so to speak completed within the shell; for this bird passes

through a moult within the egg and is able to fly at once on hatching. This is full fledged precocity in a double sense. Among the numerous precocious group who are alert, mobile, perceptive, and in a measure self-dependent in feeding when born, are the divers, the swan, the duck, game birds, gulls, ostrich, shore birds, grebes. The grebes, however, need — and get — special lessons in diving and catching fish.

Between the precocious group (the nidifugous group) and the helpless (nidicolous group) Mitchell recognizes a smaller group which numbers birds of prey — the eagles, hawks, vultures, herons, owls, pigeons, storks. The precocious group is relatively the most primitive; the nidicolous, the most advanced, from the standpoint of comparative psychology; but even in the intermediate group there are noteworthy manifestations of infancy and prenatal care. Abundant and brilliant evidence of this will be found in H. B. Macpherson's monograph on "The Home Life of the Eagle," a book which proves anew the scientific value and interest of detailed, *dated* life histories, of which there are so few in the literature of behavior.

### 3. THE BEHAVIOR GROWTH OF THE GOLDEN EAGLET

Mr. H. B. Macpherson made the observations for his fascinating monograph[1] in a lone mountain fastness of the Grampian range, "a dwelling place meet for the King of Birds and his royal spouse." The observations, aided by a camera, were accomplished from a cave built into a cliff, and required great patience, endurance of difficult weather, and even bodily risk. From this monograph, illustrated with remarkable photographs, I have compiled what amounts to a developmental log of the golden eaglet. The story of

[1] Macpherson, H. B., *The Home Life of a Golden Eagle.* London, 1909, Witherly and Company. Pp. 45. 32 photographic plates.

development when thus recapitulated bears interesting suggestions as to the biological significance of all infancy.

### Developmental Log of the Golden Eaglet

| *Postnatal Age* | |
|---|---|
| May 12 — 0 (Birth) | Hatched in its mountain eyrie (at 3000 feet elevation) (from an egg, almost white, bearing a close resemblance to a giant egg of a barnyard fowl). |
| ***One Week*** | Grips with claws, powerfully and tenaciously.<br>Stands nearly upright.<br>Startles from novel intrusion. |
| ***Two Weeks*** | Squeaks lustily, looking up when mother returns with no food. Tries to crawl to mother, but unequal to effort. Huddles under protecting breast of mother during storm. (Mother turns head and looks at eaglet from time to time.) Feeds from mother's beak on tit-bits of liver and grouse (but no four-footed flesh). (Fed with great regularity twice a day — at daybreak and about 5 P.M. Rabbits are stripped of fur with incredible speed while eaglets are still in the first down. Cock splits open grouse for the convenience of the young.) Eaglet dozes after meal. Mother returns to eyrie from time to time between meals to inspect young. Mother cleans nest, removing castings, at dawn. |
| ***Three Weeks*** | First lesson in feeding self. (Mother holds carcass, cleared of entrails, toward eaglet.) |
| ***Four and One-Half Weeks*** | Tries to walk and falls forward ignominiously. Perseveres an hour and partly succeeds. Makes extraordinary progress in walking lessons *next* day. First dark feathers sprout on wings. |
| ***Six Weeks*** | Shows rage, opening beak and crouching when molested. Can rush forward, but has not yet learned to stand on prey and grip it with feet. Makes toilet by plucking down. Plays with bits of heather and moss. Lifts them from ground and throws them down again. Makes playful |

Developmental Log of the Golden Eaglet — *Continued*

| *Postnatal Age* | |
|---|---|
| | grimaces, turning head sideways and upward at same time in comical manner. "He behaved exactly like a child thrown upon its own resources for amusement and compelled to fall back upon any article as a toy." Ventures to edge of abyss and watches mother circling below. Tries to open carcass of leveret but fails. |
| *Seven Weeks* | Eaglet has reached almost the size of parents. When hungry, flaps wings incessantly "like a child who has not had enough to eat." Swallows first bones of leg of rabbit. Mother "shows him" how to split leg at joint preparatory to swallowing. (This was learned in about a week, apparently.) Covers prey protectively while he eats, even when alone. |
| *Eight Weeks* | First lesson practising use of wings, standing erect, flapping wings vigorously for some seconds on end, several times during day. Takes short excursions from eyrie, walking on ledges. |
| *Nine Weeks* | Balances self insecurely on a stone, using wings to reach position. |
| *Ten Weeks* | First flying lessons, mother enticing eaglet short distance by proffering and withholding food. |
| *Eleven Weeks* | First adult yelp in answer to mother's yelp. Spreads out his giant wings and vanishes in full flight. |
| *Twelve Weeks* | First lesson in hunting prey. Catching grouse and later hare, on the wing. |
| | Buffeted by parents and driven forcibly from home by them. |

Interesting counterparts of human and infrahuman infancy are glimpsed in the foregoing developmental history; even in ". . . the last and strangest scene in this drama of the eagle's life, when the devoted parents, who, for long months have tended their offspring with loving care, turn on him as on a foe and drive him forth into the outer world."

### 4. DOMESTICATION AND INFANCY

Birds have been aptly called "glorified reptiles." They constitute a lateral branch of the main trunk of the phyletic tree. Whether they represent a phyletic order or type of mind which is distinctive and impossible to construe in ordinary psychological concepts, is at least a speculative query. The psychology of mammals does not suggest this query to the same degree. The characteristics of infancy among the higher mammals, particularly the anthropoid primates, justify a comparative study and a search for psychological homologues of human development. Some reference must be made to the infancy of familiar household pets and the domesticated animals of the farm. These creatures are so familiar that there is a relative paucity of scientific data in regard to their life histories, especially from the standpoint of behavior development.

One interesting feature of the infancy of dog, cat, horse, and cow that differentiates it from that of wild creatures, is the influence of domestication. These animals are reared in close contact with man. In the case of cat and dog this human association is intimate, and indeed alike; but the dog has remained a dog, the cat, a cat. The dog, to be sure, is well-nigh subservient; but his qualities have been the result of selective breeding, rather than genuine domestication. He has not been civilized through a modification of the wolf nature which was his ages ago when he was first adopted by man in his puppyhood. The effort to domesticate the dog represents a longer and more systematic experiment with the plasticity of infrahuman infancy than any laboratory could devise. Countless generations of dogs have been bred from infancy by the stern and the loving hand of generations of men; but dogs they remain. The broad but significant

conclusion to be drawn from this fact is that the plasticity of even a gregarious beast is specific and selective. It is not sufficiently generalized in character and quantity to make possible any rapid or radical alteration of character. Dog he remains, and Robinson is perhaps right when he suggests that the dog perceives his master as a sort of bipedal leader of the pack, the household and the neighbors' dogs constituting the rest of the pack.

It is tempting to reverse the psychological question and to ask, What would happen if an opposite and adverse fate placed a human infant among quadrupedal wolves? Kipling's Mowgli, and Romulus and Remus, are partial answers to the question. The recent tales of wolf children in India, which have some basis in fact, and the wild boy of Aveyron, also throw light on the subject. But human adaptation to wild conditions of life only represents an abnormal kind of conditioning; and does not in any sense call into question the grade and degree of plasticity in man.

Coming now to the order of primates, we must undertake a brief comparative consideration of the developmental characteristics of the anthropoidea, among whom man himself is classed. In the monkeys and apes, infrahuman infancy reaches its highest levels of expression, and its closest approximation to early human behavior. How thoroughgoing is the approximation? How fundamental and how consequential? Is the resemblance valid, or must it be discounted? Do the correspondences and the disparities throw any light on the distinctive elements in human infancy? On scientific grounds these questions are inescapable, even if the answers are not forthcoming. The questions deal with truth and are sufficiently important to warrant a suspension of prejudice in an effort to consider them.

## 5. COMPARATIVE ASPECTS OF INFANCY IN THE PRIMATES

Definite data in regard to the life histories of monkeys and apes are surprisingly meager and fragmentary; and the importance of this field of study has been stressed by Yerkes. Fortunately, however, there are notes available on the development of a young monkey. These observations on a macaque in captivity were made by Lashley and Watson[1] and cover a period of four months, dating from birth. The *macacus rhesus* is a monkey of the old world. At birth its body length was 20 cm. In four months it had attained the proportions and nearly half the length of an adult. The course of its motor development may be briefly recapitulated in tabular form. In drawing up this table I have assigned the approximate age at which a comparable motor ability or behavior event occurs in the life of an average human infant; basing the age assignment on our normative data. These comparative figures reveal the amazing "precocity" of this monkey species. (See table on page 345.)

The extraordinary rapidity of the motor development of the macaque is apparent from the adjoining table. Indeed the general development, in spite of some lack in muscular control, proceeded so swiftly that by the tenth week the observers considered that the young monkey was mature in all but the sexual activities. The comparative table brings out the interesting fact that in many items the macaque developmentally achieves in a day what the human infant attains in a month. A precocity ratio of thirty to one!

To what extent is the macaque able to maintain this startling lead? Let us assume that it has the added environmental impetus of close association with man. How far does

[1] K. S. Lashley and J. B. Watson; "Notes on the Development of a Young Monkey," *Journal of Animal Behavior*, Vol. 3, 1913. Pp. 114–149.

this precocity influence its ability to profit by experience? What is its comparative status in adult years?

The reader's familiarity with both old world and new world monkeys will provide a general answer to these questions.

Chronological Table Comparing the Ontogenetic Ages of Similar Developmental Items in Macacus Rhesus and in Man

| Developmental Items | Age of Appearance in Macaque | Age of Appearance in Man |
|---|---|---|
| Crying, sneezing, suckling, winking . | 1 day | 1 day |
| Response to sound (unadaptive) . . | 2 days | . . |
| Head and eyes turn to follow object . | 3 days | 2–3 mos. |
| Grasp at object seen (visual stimulus) . | 5 days | 5–6 " |
| Recognitive responses to sound . . . | 11 " | . . |
| First attempt to walk . . . . . . | 12 " | 12 " |
| Solid food first eaten . . . . . . . | 4 wks. | 6–12 " |
| Scoops objects with palmar prehension | 3 " | 6 " |
| Opposes thumb and fingers . . . . . | 5 " | 7–10 " |
| Sustains weight by reflex clasping . . | 0–3 days | 0–3 wks. |
| Plucks pellet (or grain of corn) opposing thumb and fingers . . . . . . . | 6 wks. | 10 mos. |
| Attempts to draw mother into play . | 5 " | 10–18 " |
| Holds head up steadily and gazes about | 5 days | 3–4 " |
| Follows moving hand with eyes . . | 6 " | 3–4 " |
| Attempts to crawl . . . . . . . | 12 " | 9 " |
| Runs (trots) . . . . . . . . . . | 14 " | 18–24 " |
| Weaned . . . . . . . . . . . | 7 wks. | 6–12 " |
| Crumpling explorative play with paper | 8 " | 6–9 " |
| Attains virtually all adult vocalizations | by 9 " | 12–24 " |
| Duration of Gestation . . . . . . | 168 days | 280 days |

He has seen the dressed up monkey of the organ grinder, and framed some opinion of its psychology. This variety of monkey belongs to the family of cebidae (new world). The writer claims no extended knowledge of cebidae, but ven-

tures to report the results of an hour's observation which chance made possible on a summer holiday several years ago. It was an adult *cebus sapajous*. Its master was coöperative, brought Jocko into the house, and permitted us the adventure of making a few psychological performance tests on his nimble charge. We used simple test material and improvised equally simple test situations.

It was astonishing to find how suitable these informal tests proved for our unusual guest. Jocko made no trouble and inflicted no damage. To be sure, he jumped actively upon chairs and table, and had to be kept on leash; but he responded positively to many of the "problem" situations which were rapidly placed before him. The fact that we were able to conduct any induced observation at all, is itself significant.

We shall merely relate what happened in the several simple test situations. Jocko was five years of age, fully matured, when we saw him. His body length was almost two feet. He cost two hundred dollars! There are no other introductory data. He was doubtless reared from infancy by a South American dealer. In the following present tense record of performance the test situations will be briefly indicated in italics:

1. *Playing with blocks.* Some small red cubical blocks are offered to Jocko. He takes one, then another, then another, gathers them together, and occasionally throws one on the floor. Jocko cannot be persuaded even with liberal demonstration to build them tower fashion one above the other. Whether under modified conditions he could be motivated to display requisite insight to build a tower, is another question. Jocko frequently puts a cube into his mouth.

2. *A Simple Commission.* Jocko on demand, supplemented by gesture, will place a cube in a box, apparently

letting go of it with some difficulty. Jocko will place one or more cubes in a cup; he will also hand a cup to me on the master's command.

3. *Cup and Cube.* We place a cube under a tin cup. Will he secure the concealed cube? He regards the handle of the cup. He lifts it by the handle and puts it to his mouth, but apparently he ignores the cube. We try again and again; but the cup-to-mouth reaction predominates all others.

4. *Cup and Candy.* We alter the situation; we motivate his intelligence; we give him half of a candy wafer; we place the other half under the cup; we say, "Go to it, Jocko!" — And Jocko does. He lifts the cup and promptly snatches the candy, and then — but not till then — does the hand-to-mouth reaction prevail.

5. *Removing Wrapping from Candy.* A piece of candy is wrapped up in paper before the subject's eyes. He is then given the paper. Jocko scored a brilliant success on this test.

6. *Manipulation of Paper.* When given paper to play with, Jocko's reactions were lively but uncritical. He exploited the paper, waved it, and threw it. He would not fold it. He was, however, "interested" in the paper as play material.

7. *Scribble and Crayon.* Jocko took the red crayon, but he failed to rise to all of the opportunities. He could not make a scribble mark in spite of our dramatic demonstrations. He did his best. He applied the crayon to the paper; but it was only a banging staccato. Jocko did two other things with the crayon: he put it to his mouth, and he threw it away.

8. *Form-Board.* We placed before Jocko a few simplified form-board problems. We "asked" him through gesture to put a small rod into a round hole. He banged the rod undiscriminatingly on the box and made not even an awk-

ward attempt to solve the real problem. Likewise when the circular block was given him to place in a circular hole. He pounded with the block and put it into his mouth, but made no Montessori response.

9. *Form-Board Box.* It is significant, however, that when the test situation was slightly altered for Jocko, he virtually solved the problem, even if it was not by a deliberate form-matching geometric judgment. Recognizing Jocko's interest in boxes, and his proven ability to introduce articles into boxes, we took a small pasteboard box, covered the opening with a portion of the form-board so as to leave the circular aperture. We then gave him the circular block and directed him to put it in the box. This time he succeeded in putting the block through the round hole; this was evidently quite different from the more abstract form perception — form placement situation of the ordinary form-board.

10. *Pellet Prehension.* This is an interesting motor test — nothing more than a tiny pellet to pick up from the table. Jocko picks up the pellet with a swift, sweeping, palmar scoop. We detected no evidence of handedness in his prehension and manipulation.

11. *Tricks.* Now in the matter of tricks Jocko makes a good record. He can clap his hands, he can doff his cap, he can put his cap strap under his chin; he can put a stick behind his head; he can turn a somersault. Such virtuosity, although it puts Jocko in his best light, perhaps also reveals his limitations. With all his training and intimate association with man, *this* is the sum of what he has learned.

It would be a profitless task to review the performances of Jocko and to assign to them psychological age values in human terms. The superficial resemblances between infantine and infrahuman behavior are apparent enough; but they are offset by such profound contextual and configura-

tional differences that it would be quite misleading to establish a parallelism by means of the common denominator of mental age, — a numerical device which must be used with clinical caution even when human individuals are compared, and which fails utterly for interspecies comparison.

A concluding word as to the manner of Jocko's behavior. In his manipulations, Jocko moves very swiftly. He pounces and snatches with an amazing speed which imparts an aspect of superhuman alertness. And yet his lack of restraint makes him also seem nondeliberative. He does not appear to fall into those depths of wrapt attention which are part of the character and the charm of the human infant. Even though Jocko by this time should have the conservatism of his mature years, he seems less tentative, less adaptive, in a word less sapient, than the infant *homo sapiens*.

The net result of this comparative sketch is not embarrassingly favorable to the anthropoid. Although there are striking interspecies correspondences which must have a broad biological, if not evolutionary, significance, the human baby is immeasurably superior for the reason that he is only in the first stages of a span of immaturity which reaches down the long years. His wisdom tooth does not erupt until the age of twenty-four, while Jocko at the age of five is in his prime or past it. This long period of human immaturity is one of endless learning, during which the child comes into the rich social as well as physiological inheritance of the race. This social inheritance, in part, consists of a mechanical street organ which plays Yankee Doodle when you turn the handle; it includes a leash with a collar for Jocko's neck.

And the children of the street dance to the music, and part of their enjoyment of the whole situation lies in a

delicious sense of superiority which they rightly feel when they see that ridiculous little monkey!

*      *      *      *      *      *

Above monkeys in the order of primates rank the anthropoid apes, which include gibbon, orang, chimpanzee, and gorilla. When these two groups (monkeys and apes) are compared, the significance of the prolongation of human infancy is again forcibly illustrated. The duration of the infancy in the anthropoid apes is considerably greater; but again not as great as in the lowest of human races.

A. R. Wallace when in the Malay archipelago had an opportunity to compare a monkey (m. *cynomologous*) with a young Mias or orang-utan which he had captured. He reports as follows: "It was curious to observe the different actions of these two animals, which could not have differed much in age. The Mias, like a very young baby, lying on its back quite helpless, rolling lazily from side to side, stretching out all four hands into the air, wishing to grasp something, but hardly able to guide its fingers to any definite object; and when dissatisfied, opening wide its almost toothless mouth, and expressing its wants by a most infantine scream. The little monkey, on the other hand, in almost constant motion, running and jumping about wherever it pleased, examining objects around it, seizing hold of the smallest objects with the greatest precision, balancing itself on the edge of a box or running up a post, and helping itself to anything eatable that came in its way. There could hardly be a greater contrast, and the baby Mias looked more babylike by the comparison."[1]

[1] Wallace, A. R., *The Malay Archipelago*, New York, 1869. Harper & Brothers. Pp. 638. Wallace delightfully recounts other details about his orphan infant Mias, for whom he "endeavored to make an artificial mother, by wrapping up a piece of buffalo skin into a bundle, and suspending it about a foot from the floor!" (P. 54.)

The last statement is particularly significant, even though paradoxical. At a later stage the paradox is reversed, for in maturity the orang-utan is markedly in advance of the monkey in behavior equipment.

In support of the last statement may be cited the findings of Yerkes in his multiple choice tests. The monkeys learned slowly with a gradual elimination of errors, while the orang solved his problem suddenly, in a manner that suggested ideation. The orang-utan grasped or sensed a relation of "middleness" when the middle object of a series was always associated with a reward.

Although there is now a considerable literature on the psychology of the chimpanzee, most of the work has been confined to animals of uncertain age in the period of adolescence and later childhood. Only a few specimens have been successfully reared from birth in captivity; there are no published systematic observations of their infant behavior. Reaching for objects on sight begins, apparently, at the end of the third month. This is impressively later than the third week, the nascent period for reaching in the macaque. Lessons in walking begin at about the fourth month. As early as the third week the young chimpanzee is cuffed by the mother to keep it quiet. Yerkes estimates the period of early infantile development to extend to approximately one year — ". . . for by that time the individual is able to run about and partially support itself independent of the mother or nurse; the period of childhood, beginning perhaps in the second year, and characterized by extreme activity, playfulness, mischief, and irresponsibility, runs at least into the fifth year. Then begins a period of adolescence, which extends perhaps to the seventh or eighth year in the female, and the ninth or tenth year in the male, and is comparable with the human span of life of six to twelve in the girl, and

eight to fourteen in the boy. Facts are too meager to justify comparison of the span of maturity in chimpanzee and man, but there is a high degree of probability that if individuals of the two species were kept under equally favorable conditions, they would live to a similar ripe old age."[1]

As early as the fifth year the chimpanzee performs acts of adaptive behavior which indicate insight, and possibly ideation. The chimpanzee possesses color vision, can distinguish white, grey, and black; can be trained to match simple objects like spheres, cylinders, and cubes; can retain a visual impression for at least fifteen seconds. The chimpanzee can use a stick as a tool to attain an inaccessible object; it can use a small stick to gain a long stick in order to utilize the longer stick to secure the coveted banana. Koehler has shown that it can join together two sticks, fishing-rod manner, to serve as an aid to remote reaching. To this degree the chimpanzee not only uses a tool but contrives one. If the banana swings too far overhead to be obtainable by a leap, it will stack two, three, or four boxes to secure the objective.

When can the human infant perform similar feats? It will be no easy task to create total situations in which the conditions are fully comparable. This much may be said, however, that in the nursery the child may spontaneously climb a chair to obtain objects out of reach, by the age of two years. He can stack building blocks into towers of three or more as early as eighteen months, and this without a food motive. In a rough, descriptive manner it may be said that the human child at eighteen, twenty-four, or thirty-six months, is solving problems very much like those which a chimpanzee under experimental conditions can also

[1] Yerkes, Robert M., *Almost Human.* New York, 1925, The Century Co. Pp. 278.

solve. This does not however mean that he solves them in a chimpanzee manner.

Since the development of adaptive behavior is a genetic problem, it is of fundamental importance to record chronological age and to build up data with systematic reference to agedness. But it is questionable whether mental age equivalents can be of any great service. Enough sins have been committed in the name of mental age to justify extreme caution in affixing such ages to the behavior complexes of different species.

### 6. THE UNIQUENESS OF HUMAN INFANCY

A limited psychometric point of view would make us content to measure separate capacities and degrees of difficulty, and conclude that the superficial equivalences bespeak a common behavior equipment. As a matter of fact, such similarities are but the starting point for the reconstruction of the mental life of the infrahuman creature. The actual "meaning" of any behavior in any individual can be appreciated only in terms of its genetic configuration, that is, its historic relation to his past and future career. The relation of the measured behavior to the total economy of the individual's life cycle is significant. The determination of ontogenetic ages of representative abilities in different species becomes significant when these ages are used to define comparatively the characteristic growth patterns and developmental cycles peculiar to each species.

That a growing orang-utan will at a given nascent age reach for a cube, is an interesting fact and establishes a certain similarity with the six months human infant; but the similarity is offset by a mass of contextual differences. The similarities are apparent; the differences are hidden and profound. Yet in these differences resides the uniqueness of

human infancy; a uniqueness which makes itself manifest very early. At no phase of the entire life cycle are infant and simian the same. The human characteristics are not added as an installment upon a lower primitive stage; but they inhere in the beginnings of the infant's behavior.

The preëminence of human infancy lies in the prolongation and deepening of plasticity. There is specific maturation of behavior patterns as in subhuman creatures; but this proceeds less rigidly and the total behavior complex is suspended in a state of greater formativeness. This increased modifiability is extremely sensitive to the social milieu and is constantly transforming the context of adaptive behavior. In the impersonal aspects of adaptive behavior of the nonlanguage type (general practical intelligence) there is a high degree of early correspondence between man and other primates. This correspondence may prove to be so consistent in some of its elements as to suggest evolutionary and even recapitulatory explanations.

But transcending, pervading, and dynamically altering that strand of similarity is a generalized conditionability and a responsiveness to other personalities, to which man is special heir. This preëminent sociality exists even through the prelanguage period, long before the child has framed a single word. Herein lies his humanity. This humanity does not wait for upright posture and speech. It is present at birth. It came, to be sure, late in the history of the race, but it arrives early in the history of the individual.

# CHAPTER XVII

# GROWTH POTENCY AND INFANT PERSONALITY

## The Problem of Heredity in Relation to Mental Growth

There are two sharply contrasted doctrines of development. One emphasizes heredity and the powerlessness of environment. The other exalts environment and makes it the architect of the growing organism. The former doctrine traces the make-up of the individual to all determining unit characters or genes. Even complex psychological characteristics are attributed to these original packets of chromosomal material. The alternative doctrine suggests that even physical characteristics are molded by the conditions of development; and that mental characteristics, including capacity, talent and temperament are ultimately the result of training and conditioning.

Such contrasts in developmental doctrine are to be found not only in theoretical discussions but in the literature of education and reform. When Robert Owen founded the first nursery school in America just a century ago he was moved by an ardent faith in environment. At the National Capitol before the President, the Congress, and the Supreme Court, he stated his faith in these words:

"External circumstances may be so formed as to have an overwhelming and irresistible influence over every infant that comes into existence, either for good or evil; to compel him to receive any particular sentiments or habits, to surround

him through life, with the most agreeable or disagreeable objects, and thus at pleasure make any portion, or the whole of the human race, poor, ignorant, vicious and wretched; or affluent, intelligent, virtuous and happy."

### 1. THE INTERDEPENDENCE OF HEREDITY AND ENVIRONMENT

Where does the truth lie? Probably not at either extreme. The opposition of doctrines of development has led to an overrigid distinction between intrinsic and extrinsic factors. Proverbs, metaphors, and epigrams have conspired to widen the cleavage between nature versus nurture, instinct versus habit, inheritance versus training, original versus acquired capacity. We have so overconventionalized the concepts of heredity and environment even in scientific textbooks that these concepts have become antithetical when they are in fact supplementary and reciprocal. In the field of mental inheritance there are further sources of confusion. The geneticist tends to speak of mental traits as though they were discrete faculties and lumps them with physical unit characters. The psychologist on the other hand is prone to argue in terms of a discrete, hormic mind independent of the bodily structure.

Here again the concept of growth proves its value. It leads to a depolarization of the two opposing categories of heredity and environment. Growth always represents a continuum; it therefore becomes unnecessary to draw a sharp distinction between physical and mental manifestations. Growth is also a process of integrative organization; it thus becomes desirable to consider *conjointly* the factors which enter into the shaping of the individual. From this point of view the organic mechanism of development and the reciprocal rather than the contrastive influence of

heredity and environment is of chief concern. The interest shifts to the *conditions* of development, and to the projective influence of one stage of development upon another stage. Growth is constantly creating its own conditions. It is important not only to recognize the germinal determinations which underlie the growth process, but the regulatory influence of the very products of growth.

The supreme genetic law appears to be this: All present growth hinges on past growth. Growth is not a simple function neatly determined by X units of inheritance plus Y units of environment, but is an historical complex which reflects at every stage the past which it incorporates. In other words we are led astray by an artificial dualism of heredity and environment, if it blinds us to the fact that growth is a continuous self-conditioning process, rather than a drama controlled, *ex machina*, by two forces.

It follows from these considerations that it is impossible to determine in any precise way the exact degree of hereditary versus environmental influence in early mental development. At the present stage of knowledge it is important to avoid any over simplification of the problem. Bearing these difficulties and reservations in mind, we may, however, presently examine the drift of our available data, and venture some suggestions as to the relative rôle of inherent and induced factors in the mental growth of the infant. It will be understood that the so-called inherent factors may from a strict biological point of view often have a secondary or derived aspect. For example, the genesis of the eye in the embryo is due to an inherent, specific organ-forming substance in the genes. This is a primary chemical differentiation; but even this self-differentiation is under the influence of an organizing center and of gradients from which influences spread. The early development of the organ is furthermore regulated by

its position in relation to other organs. This is a form of dependent differentiation, in which mechanical and physical influences come into play. After the attainment of histological differentiation of the tissues, the organism begins to function as a more or less integrated individual. From then on four new processes come into operation — "the trophic influence of nerves; the circulation of growth-modifying internal secretions; differential growth along different axes; and the adaptational effect of function."

Although these refinements belong to the field of experimental biology and cannot enter into a discussion of mental inheritance, they should at least figure in the background of such discussion, as a corrective against uncritical generalization and "inspired thinking."[1] It is apparent that biometry, although it must supply the measurements and statistics of individual differences, cannot elucidate the actual mechanism of individual differentiation. This is a problem of physiology, and the pioneer investigations of developmental physiology are already putting the traditional question of Nature vs. Nurture in a new light. The genes initiate the process of development and determine its sphere and limits; but the process continuously creates its own inner control.

## 2. EXPERIMENTAL STUDIES OF MATURATION

One approach upon the problem of the development of behavior lies in the study of maturation. The phenomena of maturation in relation to function and experience furnish

[1] The reader may be referred particularly to H. S. Jennings: *Prometheus, or Biology and the Advancement of Man.* Dutton & Co., New York, 1925, 86 pp.; and to Julian Huxley's "The Tadpole: A Study in Developmental Physiology," the concluding chapter of his essays in *Popular Science.* Alfred A. Knopf, New York, 1927, 316 pp. See also Frank R. Lillie, "The Gene and the Ontogenetic Process" in *Science,* October 21, 1927; vol. 66, pp. 361–369. An extended bibliography will be found in Thomas Hunt Morgan's *Experimental Embryology,* New York, 1927. Columbia University Press, p. 766.

some hint as to the potency of innate growth factors. By maturation is meant the inherent progressive alteration which tends to bring a growing organism to a state of completeness. It is a more restrictive term than growth and is intended to designate those changes which are primarily dependent upon nutrition and duration, rather than extraneous factors.

An ingenious experimental study of the problem of maturation was made by Carmichael.[1] He removed a group of frogs and salamanders from the influence of external stimulation during their early development. His method was as follows: The embryos were divided into two groups, a control group, which were permitted to develop naturally in tap water; a narcotized group which were drugged with chloretone solution in their early head and tail-bud stages. The drugged embryos remained motionless, even to tactile stimulation of the body skin. They did not swim at their appointed time because of their anesthesia. The control embryos, however, reacted to touch, and duly displayed their natural swimming movements.

The drugged embryos were then denarcotized by the simple process of transferring them to tap water. And they swam even though they had not ever swum before. In fact some of the salamanders promptly swam so well, "that they could with difficulty, if at all, be distinguished from the members of the control group who had been free-swimmers for five days." The swimming reaction was not, however, perfect at the first trial; there was a continuous series of increasingly complex responses from an initial twitch to full coördination.

[1] Carmichael, L., "The Development of Behavior in Vertebrates Experimen[illegible] Removed from the Influence of External Stimulation," *Psychological* [illegible] 1926, Vol. 33, pp. 51–58.

The experimenter does not conclude from this striking result that function and experience are of minor importance in the economy of growth. On the contrary he inferred that the results "indicate the interdependent action of both heredity and environment in determining the functional development of the individual." He is in accord with Child's view that "living protoplasm is functioning at all times and development is a process of functional construction, that is beginning with a given structure and function, the continuance of function modifies the structural substratum and this in turn modifies further function and so on."

The general problem of maturation has been investigated in great detail by G. E. Coghill in his "Correlated Anatomical and Physiological Studies of the Growth of the Nervous System in Amphibia." [1] The studies were based on numerous systematic sections of the nervous system, and cell count delineations of the neurones at different levels and stages.

Coghill found that the innate maturation of the nervous system determined its primary structure, and that function or exercise did not even hasten the various types of reaction. He infers that the specificity of nervous structures in terms of behavior is "determined by laws of growth in which the behavior values of the patterns of response have no part."

But he also notes that mere maturation results in stereotyped performance, that even in such a function as swimming "the early growth of association neurones into the motor mechanism introduces unpredictable elements in behavior." This progressive, adaptive mechanization of the association

[1] Six of these studies have appeared in Volumes 24, 26, 37, 40, and 41 of *The Journal of Comparative Neurology*. The last of these deals with "The Mechanism of Integration in Amblystoma Punctatum." See also G. E. Coghill: "The Growth of Functional Neurones and its Relation to the Development of Behavior." Published in *The Proceedings of the American Philosophical Society*, Vol. 65, No. 1, 1926.

systems is equivalent neuro-embryologically to habituation and conditioning of reflexes.

Although the development of the nervous system of vertebrates does not proceed in a homogeneous manner, it appears from the beginning to maintain the integration of the individual. Separate reflexes do not grow independently to be later combined into a total unity; but "arise by a process of individuation within a primarily integrated total pattern." It is quite conceivable that the integrity of the infant as well as amblystoma is preserved in the same manner. There is no suggestion that the growing complex of infant behavior can be accounted for by a combination of smaller behavior units.

The following conclusion is of such fundamental import for the theoretical interpretation of behavior development, that it should be quoted in full from the author's monograph:[1]

"The form of the behavior pattern in Amblystoma up to and including locomotion is determined by specific neural counterparts that acquire their specificity in functional value through laws of growth in the nervous system. There is evidence also that mechanisms that condition the performance of such a behavior pattern as locomotion in mammals are determined in the same manner. It is important, therefore, to know how far growth, in the sense of the differentiation of new functional parts of cells, is projected into the life-history of the vertebrate, for so long as it continues it must participate in the function of the nervous system as a whole and, therefore, in the development of the behavior pattern."

Here we glimpse the meaning of growth as opposed to learning in the traditional and somewhat mechanical sense.

[1] P. 136, *Journal of Comparative Neurology*, Vol. 41, No. 1, August, 1926. The Wistar Institute Press, Philadelphia, Pa.

It appears that through growth, experience becomes incorporated into the maturing nervous system. Tanzi and Cajal suggested that function or exercise activated the growth of the nerve cells. Coghill holds that the nerve cells grow by their own intrinsic potentiality, and that while growing the nervous mechanisms acquire their behavior specificity.

Not the least value of this conception of the growth of neurones in relation to behavior lies in the constructive effect which it has on the nature versus nurture antithesis. Original growth potency becomes the fact of basic importance; but this potency is realized in no foreordained detail. Experience and milieu enter into the very process of growth.

### 3. THE INHERENT BASIS OF DEVELOPMENTAL TREND AND TEMPO

Recognizing, then, the intimate interplay of innate, induced, and environmental factors, we may inquire into the rôle of heredity in some of the major aspects of mental growth set forth in preceding chapters.

The tempo and trend of development in each infant appear to be constitutional characteristics, for the most part hereditary in nature. In cases of secondary amentia the retardation of developmental rate is, of course, acquired. The deficiency then becomes part of the constitution of the child, and the "retardation" is symptomatic of impairment of structure and reduction of developmental potency. Such potency as remains, however, is part of the original nature of the child. The reduction of potency may occur in utero, at time of birth, or postnatally. The reduction may be complete or partial, selective or symmetrical; and in any given case the developmental end-results depend chiefly upon the original deprivation rather than the later environ-

mental opportunity. In certain injuries to the central nervous system, however, there is an indeterminate reserve of nerve-cell tissue, which can undergo substitutive or compensatory development. The effectuality of training and environment will then depend upon the age at which the damage occurred, the amount of available compensating tissue, and the intensity of the demand upon it. When these factors conspire favorably, certain "hopeless" cases of motor disability undergo remarkable improvement under the stress of effort and training. Here the rôle of environment is critical.

It is significant that for many cases of mental deficiency the cause is quite obscure. In the absence of a frank illness, injury, or trauma, the temptation is to ascribe the deficiency to germinal defect. The possibilities of defective growth regulation in the early embryonic period are however, theoretically, so numerous that many of these instances of congenital defect cannot be safely ascribed to faulty genes. The defect, however, is constitutional and the lowered tempo and lowered trend of development are as ineradicably part of the physiological equipment of the individual as the skin pattern of his hands.

The mental growth curves of the six siblings reported in Chapter VIII are strongly suggestive of underlying hereditary determination. The curves represent two highly contrastive types of growth. It is scarcely conceivable that such a consistent disparity could arise out of some subtle difference in nutrition, hygiene, or household conditions for the two groups. The children were reared in the same home by the same hand. It is more conceivable that a decisive difference in the germinal determinations account for both the average and the reduced growth potency.

Acceleration of development, likewise, is typically an

inherent biological characteristic of the individual, most probably hereditary in nature. There is no convincing evidence that fundamental acceleration of development can be readily induced by either pernicious or enlightened methods of stimulation. Through sheer conditioning and training it is possible to teach both infants and animals prodigious tricks. It is possible, also, that certain kinds of conditioning may exert a deep augmenting effect upon the dynamics of individual growth, reaching the endocrine constitution. This would be a secondary, derived kind of acceleration, comparable to the reduction of development in secondary amentia. It is a theoretical possibility rather than a frequent clinical manifestation. Abnormal forms of precocity encountered clinically are likely to be partial and unsymmetrical. They constitute atypical deviations; they may be associated with infantilism and with unusual or pathological glandular conditions. The wholesome variety of acceleration found with superior endowment, is really part and parcel of that endowment, a symptom of intensified growth, a fundamental individual difference, characteristic of, because necessary to, the developmental mechanics of certain kinds of ability. If the methods of biochemical measurement were available, it might be possible to determine certain differences in the energetics or dynamics of these rapidly growing infants, even in the first months of existence, when we could scarcely attribute their precocity to special educational or environmental stimulation.

If the superior individual as a rule mentally grows not only faster but for a longer time, this lengthened span may be regarded as primarily a manifestation of inherent endowment. That secondary, derived factors also come into play will be presently noted. The interspecies and interracial differences in the duration of plasticity are doubtless correlated with

differences in organic constitution. Within limits, comparable individual differences in the growth cycle of man may be presumed to have a similar basis.

This does not, however, exclude the operation of extrinsic influences. Whether one regards thyroid extract as an article of diet, or as a biochemical activator, it is certain that in some instances it affects the metabolism of the body so profoundly as to have a demonstrable effect upon both physical and mental growth. Here, then, an extrinsic factor modifies the tempo and trend of development. It is also possible that future insight into endocrine physiology will actually lead to a postponement and amelioration of senility. Then again the dominance of hereditary determination would give way to environmental regulation. For similar reasons it is probable that superior physical hygiene will continue to have a favorable effect upon growth, particularly in cases of previous neglect or partial deprivation. In one or two of the "atypical" growth cases reported in the foregoing section, it is possible that obscure but genuine alterations of the physiological economy were responsible for the psychodevelopmental improvement. On the whole, the stability of the developmental trend and tempo is more conspicuous than its sensitiveness to "external" influences. The case of puberty praecox described in Chapter XIII, is particularly impressive. Here adolescence was precociously displaced to the extent of a whole decade; the morphology of the body was definitely responsive to this glandular deviation; but the nervous system was only mildly deflected in its course of growth.

To what extent endocrine complexes are to be construed as genuinely hereditary is a significant genetic question. They may be in the nature of adaptations to climatic and nutritional conditions, rather than evidences of fundamental

germinal variations. Shirokogoroff[1] in his elaborate study of the process of physical growth among the Chinese holds that growth is controlled by the complex of glands of internal secretion on the one hand and the inherent peculiarities of ethnical groups on the other. The latter peculiarities are more clearly hereditary than the former. He came to the general conclusion that "The endocrine complexes define not only the process of physical growth, but the psychic behavior of ethnical units, so that the peculiarities of Chinese psychology and behavior may be explained as the result of their glandular complexes." The study of the process of growth, it is suggested, may even serve as a method of discovering the chemical components of the ethnical units. Are these components laid down in the chromosomal packets?

Clinical mongolism, which, of course, is in no way to be confused with ethnical differentiation, raises similar questions concerning the rôle of early glandular secretion. The cause of mongolism is unknown. Neuropathic heredity, familial characteristics, syphilitic, alcoholic, tuberculous and arthritic lesions are rarely and irregularly involved. More frequent are influences which disturb pregnancy such as advanced age or exhaustion of mothers, numerous previous pregnancies, privations, violent emotion, etc. But even these influences are subject to exception and to error of interpretation. The fact that mongolism may occur in one of fraternal twins, and has not been reported in only one of identical twins, suggests the existence of a germinal defect. To be so much in the dark as to the etiology of such a well-defined clinical entity as mongolism suggests the need of great caution in assigning the cause of congenital defect.

[1] Shirokogoroff, S. M., "Process of Physical Growth among the Chinese," Vol. 1, *The Chinese of Chekiang and Kinagsu.* The Commercial Press, Ltd., Shanghai, China, 1925. 137 pp.

Congenital total hemihypertrophy, particularly when found in association with mental defect, would naturally suggest a defective germ plasm. The available evidence does not support this suggestion, but favors the view that some epigenetic factors relating to regulation of symmetry are responsible for the anomaly and all its correlated disturbances in tissue development, including partial cerebral agenesis. To be sure, the imbalance in twinning may itself be ascribed to an original defect in the genes; but it is more in accord with the law of parsimony to ascribe it to some failure in the mechanism of growth regulation. However, whether germinal or epigenetic in origin, the anomaly becomes established at an extremely early embryonic period, and projects itself irrevocably into the entire growth cycle. It becomes an inherent even if not inherited character, and is an excellent illustration of projective importance of early developmental deviations.

### 4. INHERENT FACTORS IN HANDEDNESS

Handedness is a form of asymmetry which likewise may be interpreted in terms of the physiology of twinning. Perfect ambidexterity would assume ideal symmetry in body build, and complete ambivalence in the two cerebral hemispheres. Such perfect balance, theoretically and actually, must be a rarity, which, if it ever exists, tends to be overthrown even in the intra-uterine stage of development with postural and gravitational adaptations. In the great majority of instances the balance is thrown in favor of the right hand and the right eye. Accompanying, following, or determining this unidextrality is a dominance of one of the cerebral hemispheres. Is this cerebral dominance strictly hereditary, or is it an epigenetic by-product of developmental mechanics comparable in a broad way in its genesis to hemihypertrophy?

At any rate handedness becomes inherent, and becomes part of the constitutional make-up of the individual.

The fact that left-handedness is sometimes a familial trait suggests the existence of germinal factors; but not conclusively, because the sinistrality may still be a secondary by-product of a more fundamental familial trait involving vascular or anatomical peculiarities. The frequency of left-handedness in twins suggests an epigenetic factor of a regulatory nature. The increment of unidextrality at adolescence as shown by increased disparity in dynamometer records again suggests basic germinal determiners. The fact that even among left-handed and right-handed individuals there is a wide range of variation with respect to the intensity or degree of the handedness suggests that unidextrality is based on inherent constitutional rather than cultural factors.

All these considerations cast doubt on the theory that handedness is a result of social conditioning. Suppose that all the left-handed individuals in the world arose in their might and imposed a left-handed civilization for a period of fifty years. Is it probable that the infants of that era would be relatively bidextrous for six months, reach for the cube with the left hand at nine months, and be consistently left-handed at one year? Under extremely diverse, ambiguous and intermittent social suggestions, we have found that the great majority of infants of the present day show a progressive tendency toward right-handedness which becomes well established in the second half of the first year. The fact that under similar conditions a significant minority of infants show equally well defined left-handedness, is itself suggestive of more deep-seated physiological if not hereditary factors.

We may cite briefly the case of an infant who showed evidence of left-handedness in the very first day of his post-

natal existence. He amused the nurses by the vigorous manner in which he sucked his left hand. When questioned the nurses reported that it was always his *left* hand which went to his mouth. His mother, a good observer, does not recall that he ever used the right hand instead. When the time came to use the domestic implements of culture, spoon, crayon, cup, toys, handkerchief, etc., he consistently showed preference for the left hand. Pictures at this time indicate that he consistently crossed his legs in sitting posture in a manner different from his right-handed sister. His parents, persuaded that handedness was the result of social conditioning, used judicious and persistent suggestion to favor the right hand. The porridge might be eaten with the left hand, but dessert must always be eaten with the right hand. Hedonic association could not be better planned. When ready for school entrance this boy was psychologically examined. He proved to be a boy of superior intelligence, but with relatively inferior output in drawing, even though his father is an artist.

In all his manual activities he showed an inveterate preference for right to left and contraclockwise movements. When it came to drawing a locomotive with crayon, the smoke streamed to the left; likewise, when it came to reading his first letters on signs and in books, he proceeded from right to left. K. I. was read as I. K. Letters and numbers were mirror written. There can be no doubt that this boy has a constitutional flare toward left-handed performance, and would be more comfortable in a sinistral society. He is reported in this detail to show that systematic social conditioning cannot overcome inherent left-handedness; and to indicate that its inherency may date from birth.

### 5. THE EARLY GENESIS OF INDIVIDUAL DIFFERENCES

Concerning the inheritance of specific abilities, our data furnish only indirect suggestion. Specific ability in drawing, special interest in music, marked sociality, early facility in language, precocity in the use of generalizations and abstractions, all these manifest themselves in infancy in a way suggestive of native gifts or predispositions. If conditioning during infancy were responsible for such individual differences, there would be much more similarity between siblings and twins than is actually found. The extreme form of the theory of conditioning proves too much; for if it held, there would be numerous instances of bizarre ability and grotesque psychological resemblance between brothers and sisters.

Our data as a whole and clinical experience with infants give no confirmation to the theory that infants start abreast at a straight base line parallel with the threshold of birth, and that psychological differences among individuals rise by cumulative and selective action on a homogeneous protoplasmic Urstoff which in quality and amount is equally apportioned. Minute anthropometric measurements of foetuses show that racial and individual peculiarites of structure in face, hand, foot, are demonstrable in the prenatal stage. If this is true of bones, muscles, and skin, there is no reason why it should not be true of the internal structure of the nervous system. The plasticity of the nervous system is not in itself inconsistent with a considerable degree of native differentiation. The "appalling" resemblance between man and the ape in the prenatal period has been exaggerated; because beneath and beyond the resemblance are differences, less obvious but of extreme developmental importance. Indeed in this field of comparative anatomy and comparative psychology the differences are almost more

in need of scientific definition than the more easily discoverable correspondences. The study of such differences shows that the distinctive human and individual traits come not by way of addition to a common substructure, but are laid down in the substructure itself.

If we are to ascertain the genesis of human deviations we must first of all determine how early in life such deviations assert themselves. Investigation must be directed more and more to the period of infancy. The time of the genesis of individual differences is part of the question of the mode of genesis.

Bearing on this point, brief reference may be made to a study in which Miss Elizabeth Lord and the writer reported a psychological comparison of eleven pairs of nursery school children who were comparable as to age and school experience but contrastive as to the socio-economic status of their homes.[1] One child in each pair came from an underprivileged home, the other from a favored home with father or mother occupationally at the professional level. Individual tests, measurements, and clinical estimates were made of each child on fifteen items yielding 330 comparative findings. There was a definite bimodal tendency in the distribution of these findings, the higher ratings gravitating strongly to the favored group. The data suggest that the basic growth factors which will differentiate the abilities and personalities of these twenty-two children in adult years were in operation at least as early as the age of two or three years.

These differentiating growth characteristics began to operate when? The difficulty of fixing the zero point in

[1] Arnold Gesell and Elizabeth Evans Lord, "A Psychological Comparison of Nursery School Children from Homes of Low and High Economic Status," *Pedagogical Seminary and Journal of Genetic Psychology*, September, 1927.

answer to this question is itself a partial answer to the question. There is no conclusive control experiment. The same infants would have to be rereared in converse homes and converse schools to furnish complete evidence. It is probable that in the field of personality characteristics, emotional attitudes, interests, and preferences, the greatest reversal of ratings would occur. But this would not argue that the fundamental growth potency can be radically altered by a change of milieu.

It is doubtful whether the basic temperamental qualities of infants can be measurably altered by environmental influence. Training and hygiene may exert very palpable and important influence in the organization of the personality without necessarily altering the underlying naturel or habitus. We have been particularly impressed with a difference in temperamental reactions in a pair of twins, of the fraternal type, who have been under close observation for a period of several months dating from birth. Even in these early months mother and examiner are agreed that there is a consistent difference between the twins with respect to such matters as placidity, length of crying, vigor of protest, tolerance of physical discomfort, readiness of smiling, social responsiveness, etc. With the same home, the same mother, similar physical health, it is highly probable that these differences in emotivity bespeak an inherent if not inborn difference in temperamental make-up. Experience and education will not so much modify as they will (and should) be modified by this native difference. (See page 294ff.)

The temperamental characteristics of C. D. (Chapter VIII) may be recalled here. This girl exhibited a striking degree of amenability, sociality, and good nature as early as the age of nine months. We have followed her career closely. She is now five years of age, and in spite of a varied ex-

perience in boarding homes and institutions she has not lost these engaging characteristics. They are part and parcel of her make-up quite as much as the lowered tempo and the lowered trend of her general development. It can be predicted with much certainty that she will retain her present emotional equipment when she is an adolescent and an adult. But more than this cannot be predicted in the field of personality. For whether she becomes a delinquent, and she is potentially one, will depend upon her subsequent training, conditioning, and supervision. She is potentially, also, a willing, helpful, productive worker. Environment retains a critical rôle even though heredity sets metes and bounds.

The very essence of mental growth lies in this mixture of determinateness and indeterminateness. Tempo, trend, and temperament are in large measure determined by inherent or hereditary factors; but the wealth of detail in the dynamic pattern which we call personality is indeterminate until it is defined through experience. Growth potency is fundamentally dependent on original equipment; but the personality make-up is almost literally fabricated by the social conditions in which the young mind grows.

### 6. PERSONALITY FORMATION AND THE WEB OF LIFE

Indeed, the child's "personality make-up," so far as it is a describable subsisting reality, consists in the countless conditioned reflexes, associative memories, habits and attitudes which it acquires as a result of being reared by personal beings. If he were never touched by ministering hands, if he did not see and hear the evidences of humanity, if he could grow up in an absolutely asocial vacuum, it is difficult to believe that he would have any recognizable "personality make-up" at all. The balance, the topography, the well-

being of personality depend to a remarkable degree upon the impress of other personalities.

The biologist emphasizes the marvelous interrelation and integration of all the organic world or the web of life. Through the sensitive, sifting processes of evolution, all forms of life have in some way become interdependent. All species are thus adapted to each other.

This conceptual image of the web of life, Thomson[1] considers one of the four great ideas in Darwinism. "To put it in the coldest way, there seems to be a tendency in animate nature towards the correlation of organisms." "Nature is seen more and more vividly as a fabric." "The circle of one creature's life cuts into many other circles." The relationships are not in static completion or stable design. On a majestic scale which comprises the whole organic world, evolution continues to slowly modify both the organisms and the total pattern of mutual adaptations. This complex system of interrelations "forms an external registration of evolutionary gains and a sieve by which variations, sometimes subtle nuances, one might think, are effectually sifted."

The mechanism of evolution and the mechanism of growth, after all, have much in common. The most striking difference relates to time. What evolution achieves in ages, the infant in his growth accomplishes in brief moments. But he grows and adapts in a manner which is measurably comparable to the evolutionary process.

The image of the web of life is, in fact, applicable to the mechanics of personality formation. It is possible to think of each personal complex of mental growth as a brief compression of events staged in a little theater in which the

[1] Thomson, J. A., *Concerning Evolution.* Yale University Press, 1925. 245 pp.

individual achieves a unique but conditioned system of adaptations to the whole human family. Here again is a correlation of organisms, based on the interactions and the interdependencies of contiguous personalities. Here, too, in the mental development of each new infant we glimpse the strands of nature's vast web of life, a ceaseless process of adaptation to other individuals, an interplay which inevitably registers itself in the delicate tissue of the child's growing personality.

All children are thus, through correlation, adapted to their parents and to each other. Even the maladjustments between parent and child are adaptations in a psycho-biological sense and can only be comprehended if we view them as lawfully conditioned modes of adaptation. Growth is again the key concept. For better or for worse, children and their elders must grow up with each other, which means in interrelation one to the other. The roots of the growth of the infant's personality reach into other human beings.

These considerations give great emphasis to the environmental or psychodynamic importance of the parent-infant relationship. This relationship is so fundamental that it may be construed in biological as well as cultural terms. Indeed even in infrahuman family life there are noteworthy manifestations of parental behavior. The more basic principles of interaction between child and parent can be fruitfully analyzed by means of such biological categories as *parasitism, symbiosis,* and *commensalism.* In the present volume, no space will be devoted to these details. It is sufficient to point out that the personality configuration of the child is not determined by germinal constitution, and that it is a product of growth regulation. The regulation is accomplished both consciously and unconsciously through the social interaction between the young child and his house-

hold. The association of parent and child is a kind of psycho-biological partnership. It is infinitely more complicated than a mere nutritional arrangement, but it obeys similar laws of nature, and lies equally in the sphere of human control.

It appears, then, in summary, that there is a profound interdependence between "heredity" and "environment" in the control of development. These terms, from tradition, are dualistic in connotation, but growth itself is integrative and resolves the antithesis. The ancient antinomy of determinism versus freedom likewise seems inapplicable to the facts of growth. All growth is lawful and in that sense determined. The intrinsic determiners of development work in conformance to genetic laws, the extrinsic factors work in similar and coördinated conformance. The spheres of intrinsic and extrinsic influence are not separate but interpenetrate, and scientifically, if not metaphysically, it is impossible to assign a unique and absolute autonomy to any factor which enters into the growth complex. Even the originative and mutational manifestations always emerge in and out of a zone of growth. They may be unpredictable; but they are not pure miracles. From the standpoint of scientific policy they must be brought within the scope of developmental law.

There is after all a difference between predeterminism and determinism. Scientific determinism does not spell foreordination; but aims to bring even "freedom" within the limits of law and therefore also within the limits of comprehension. An absolutely whimsical and fortuitous freedom would be as offensive to understanding as a stereotyped predestination. In organic evolution and in the growth of the individual these divergent extremes are kept in progressive check and balance. Viewed from one aspect, the phenomena of growth are impressive for their conservative

stability; viewed from another aspect they are impressive for their productive fertility. Plasticity is neither a negative nor a passive character. It is a positive "function of growth," a method of transconstruction or assimilation.

The concept of heredity in its classic simplicity is contradicted by the existence of this kind of plasticity. Apparently there is a process of competition and selection in the formative complex of growth. Even native endowment comes not as a discrete bequest, but is built up through the sifting influence of competition among variable components. Some of these survive, others give way. The native endowment is thus built up through the screening stress of growth, and is a product of growth as well as of germinal constitution. Not all potentialities are realized, but only those which pass the mesh of already attained organization. All growth is self limited. Growth is mainly determined by previous growth. But this is a progressive kind of determinism which in the field of behavior, at least, comes under human control, and is inconsistent with a fatalistic view of infancy.

These considerations are general. They may be given concreteness if we formulate them briefly in terms of growth potency, personality, and the nervous system. Growth potency is broadly and fundamentally determined by inheritance. The basic developmental tempo, trend, and temperament are mainly inherent individual characteristics. Personality in its most pervasive and inclusive sense is mainly a product of the conditions of development. Maturation proceeds from intrinsic potentiality; organization issues from extrinsic and experiential determinants. But utmost realization of growth potency depends upon maximum organization.

The nervous system stands supreme among the federation of organs which together constitute the human individual.

Its supremacy consists in the function of maintaining and furthering the integrity of the body and its behavior. By virtue of this function nature has safeguarded it with certain distinctive growth characteristics. Among all the organs of the body the nervous system manifests a high degree of autonomy in paradoxical union with a high degree of impressionability. It is remarkably resistant to adversity. It withstands much deprivation. When other organs of the body starve, it does not starve as much as they do. This relative invulnerability gives it a certain stability in the somatic competition between organ systems. It tends to grow in obedience to inborn determiners, whether saddled with handicap or favored with opportunity. It responds to opportunity and capitalizes it; but its supreme function is the optimum integration of the individual in all circumstances.

All things considered, the inevitableness and surety of maturation are the most impressive characteristic of early development. It is the hereditary ballast which conserves and stabilizes the growth of each individual infant. It is indigenous in its impulsion; but we may well be grateful for this degree of determinism. If it did not exist the infant would be a victim of a flaccid malleability which is sometimes romantically ascribed to him. His mind, his spirit, his personality would fall a ready prey to disease, to starvation, to malnutrition, and worst of all to misguided management. As it is, the inborn tendency toward optimum development is so inveterate that he benefits liberally from what is good in our practice, and suffers less than he logically should from our unenlightenment. Only if we give respect to this inner core of inheritance can we respect the important individual differences which distinguish infants as well as men.

# CHAPTER XVIII

# THE CLINICAL PREDICTION OF MENTAL GROWTH

## Possibilities and Limitations of Developmental Prediction

Since prediction is a formidable, not to say pretentious, term when applied to something so admittedly complex as human development, it is desirable to subject the concept of predictability to critical consideration. Theoretically, prediction is a natural outcome of measurement. Indeed one implies the other. A perfect measurement of maturation would designate in one or more formulae an exact degree of attained maturity and a corresponding degree of potential maturity. Every moment of development (above the level of zero) possesses, so to speak, a value which is both kinetic and latent; because attained development is under uniform conditions the true index of prospective development. In this theoretically ideal sense the cycle of maturation is as predictable as the orbit of a comet, even though there is actually no mathematical methodology available; and even though an organic cycle is infinitely more complex than an astronomical one.

The intricacy of the organic cycle does not, however, in itself contradict the possibility of prediction. The intricacy is not anarchic; it is self-limited and integrated. It coheres by its own complex system of checks and counterchecks. For this reason, in spite of a stupendous range of

statistical possibilities, the growth complex pursues a course characteristic of race, individual, and age. And it is this characteristicness of pattern, tempo, and trend which come within the scope of quantitative forecast. There is after all a difference between scientific prediction and divination. Moreover, there is an ascending order of prognostication from mere possibility, to probability, to certitude. The clinical opportunity for developmental prediction lies in the judicious weighing of probabilities based upon measurements.

That the sun will rise to-morrow is a prediction. The probability is so great that it amounts to certainty (though an astrophysicist and statistician might be able to express mathematically the infinitesimal margin of doubt!). That it will rain to-morrow also is a prediction. It may be an extremely safe one if it rests on numerous convergent data. Or it may be safe for coastal New England if not for Vermont. It is evident enough that one can scarcely speak of reliability of prediction in the abstract. The reliability varies enormously with each individual complex of factors. In the field of human development, clinical method is necessary for the appraisal of such individual complexes.

## 1. THE PRINCIPLE OF PROGRESSIVE PROBABILITY IN GROWTH

The principle of all or none does not, therefore, apply to the task of clinical prediction of developmental outlook. Prediction may be carefully graduated with reference to the inherent genetic probability behind the symptoms. The symptoms may be observed in one diagnostic examination; and they may be so consistent as to be measurably conclusive for the formulation of a general prediction. The symptoms may be observed in two or more successive examinations; and *as a series* the symptoms may be so consistent as to be

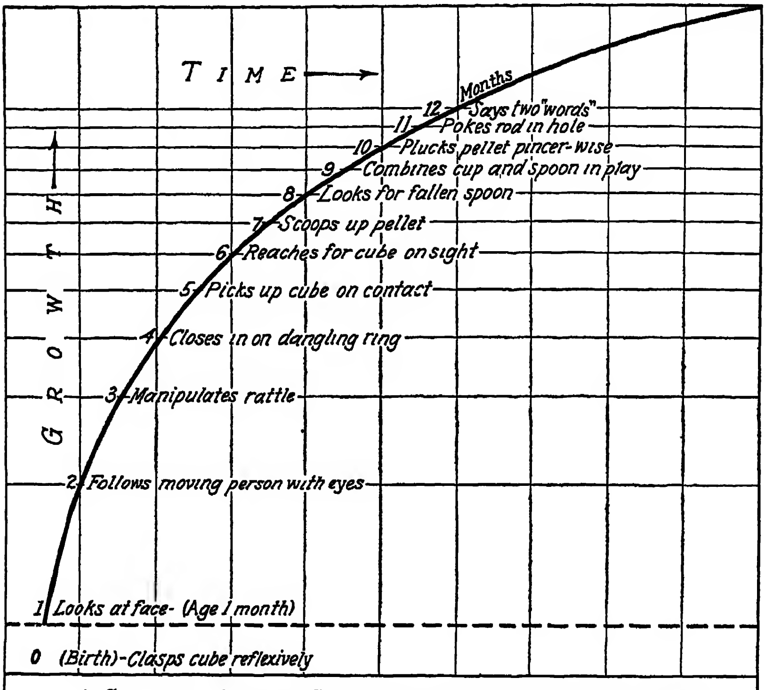
still more conclusive. In development, two diagnoses are more reliable than one. Although this is almost a truism, it deserves emphasis and even elaboration; because the method of *cumulative* diagnosis is the very one which is in danger of being neglected in actual practice. Cumulative appraisal of the same individual introduces a critical and comparative element into developmental diagnosis which makes for accuracy as well as constructive procedure.

Cumulative diagnosis rests on what may be called a principle of progressive probability. This principle can be illustrated by a concrete example. On the following page we have charted a highly simplified schedule of behavior items for the first year of life. This is, of course, in no sense a test schedule for practical application; and yet it reveals rather clearly the diagnostic force of the principle of progressive probability.

Assume figuratively for the purpose of this discussion that development climbs upward through a hierarchy of zones represented normatively by the thirteen significant behavior items from birth (0) to the first anniversary of that birth (12 months). Each developmental item is presumed to be highly characteristic of its assigned age level. The newborn child clasps a block reflexively when it is thrust into his hand. Now development is "normally" so ordered and actually so orderly, that this same infant by this token, if other things are equal, is very likely to look at his mother's face in another month. This latter item in turn augurs that he will very probably follow her with his eyes in yet another month, and close in on a dangling ring at the beginning of the fourth month. And so on, through the calendar of twelve months. Each successive timely increment increases the probability that all the remaining increments will follow in due course. There are certain qualifications which need

to be made to this rule; but for the moment we wish simply to illustrate a normative principle.

If the requisite biometric statistics were available it would be possible to add a probability index to each of the thirteen




A Simplified Chart of Symptoms of Development, Arranged Progressively from Birth to the First Birthday

**Fig. 65.**

developmental items, and this would express a predictiveness with respect to the next ensuing item. Although these items are too homely and apparently trivial to be very impressive, they are characteristic for the ages to which they have been

assigned. As progressive maturity indices they almost denote a nondefective developmental outlook for any infant who can successfully meet their requirements at each ascending age.

If we could give mathematical expression to this favorable probability we should have convincing support for the doctrine that development is lawfully coherent, and that attained development is a safe index of prospective development.

The theoretical significance of this high degree of general probability is great. It suggests that there are numerous undiscovered specific probabilities which investigation can disclose. As measurement becomes more discriminative it will also become more discriminatively predictive. It is conceivable that even the thirteen crude items in our illustrative schedule could be so refined by accurate technique and differential scoring that they would predict not only the general fact of normality but define with some precision a level or limit of later development.

There is another consideration which increases the possibility of prediction, and that is the tendency of the growth complex to assume a certain typical form and trend. This is most strikingly exemplified in mongolism. A diagnosis of this condition can frequently be made immediately after birth; and once made a definite prognosis can be outlined. If a careful developmental diagnosis is made at the age of ten months, the prognosis can be sketched in considerable detail. The general level of ability, the emotional life, the attitudes toward certain forms of work and play, the responsiveness to rhythm, the age of walking, and numerous associated characteristics can then be forecast with considerable approximation to the truth. The fact that this degree of prediction can be attained with respect to mongol-

ism, means that a comparable degree of prediction is (theoretically) possible in less pathognomic complexes. Development is equally lawful in all its expressions; and it is only the poverty of our technique which so often seems to place growth beyond the pale of prediction.

Perhaps a word should be interjected here, concerning the question of "determinism," which has already been touched upon in the preceding chapter. Prediction can, of course, reckon only with phenomena which are determined by laws of tendency or of cause and effect. Prediction will therefore deal with the basic biologic and physiologic aspects of growth potency; and only in a secondary way with the environmental contingencies. It is the task of clinical diagnosis and prediction to express this potency in general and in relative terms. Detailed specification is as impossible and as undesirable as it is in the field of vocational guidance.

## 2. THE DEMANDS FOR DEVELOPMENTAL PREDICTION

The foregoing discussion has dealt with the theoretical foundations of the concept of developmental prediction. It remains to consider more concretely the actual situations which arise in clinical work with infants and make either medical or social demands for such prediction. These situations are at present most numerous in the field of medical practice. Every case of retardation, precocity, or growth defect and many of the diseases which call for pediatric diagnosis have a forward as well as immediate import. How serious is the child's backwardness? Will he learn to talk later? When will he walk? Will he always be handicapped by his muscular difficulty? When will he outgrow his condition? Will he not overcome it at adolescence? Is it not only a passing phase? Will he respond to corrective measures? etc., etc. These questions are so

frequent and come so insistently from parents, that they call for constant appraisal of the future, and a delicate regard for what it certainly holds. Growth, quite as much as disease, falls within the scope of pediatrics and child hygiene. The fact of growth even more fully than that of health is in the consciousness of the parent, and this instinctive interest in growth places a premium upon developmental prediction. Predictive knowledge of developmental conditions must be used with great professional discretion, but it is as essential to the applications of medicine as is the prognosis of a disease.

The demands for responsible prediction are very acutely felt in all situations relating to the foster home placement and the legal adoption of infants. Is the infant normal? Will he be able to profit from school instruction when he becomes of school age? Can he go through high school? Through college? Often the specifications are pushed yet further into detail. It is because questions like these are in the minds of foster and adoptive parents, that every reasonable precaution should be taken to reduce the risks of infant adoption.

It is questionable whether any impulse to adoption which is without faith and readiness of sacrifice should ever be consummated. But the faith should not be blind. Adoption cannot be kept under social control except through the careful exercise of prediction. Adoption cannot be entrusted altogether to good will or to intuition, or even to unaided common sense. There are too many opportunities for error and miscarriage. The combined critical judgment of the social investigator, the court, the physician, and the mental examiner should enter into the regulation of adoption.

The greatest universal safeguard is a period of probation, but this cannot be wisely used unless supplemented by

clinical determination of developmental outlook. Developmental examinations are necessary likewise to reduce the number of replacements or uprootings which still figure too frequently in the lives of dependent children. Adoption therefore illustrates the close relations between prediction and social control. Enlightened control can come only through predictive anticipation. Prediction, as the term is here used, is the scientific aspect of the virtue of foresight.

Early diagnosis makes for improved control. This is a general rule and although it does not apply with equal force to all conditions, it is a sound medical precept. The rule is peculiarly applicable to problems of development, because in this field every diagnosis is implicitly also a prognosis which directs practical procedure. For scientific reasons, and ultimately such reasons have a practical bearing, developmental defects and deviations should be recognized at the earliest possible stage. We may then profitably ask, How early can these defects and deviations be diagnosed? The question can be considered with general reference to three major categories: (*a*) Mental deficiency. (*b*) Superior endowment. (*c*) Atypical deviations.

### 3. THE EARLY DIAGNOSIS OF MENTAL DEFECT

Pronounced cases of mental deficiency can be recognized soon after birth, by behavior symptoms, whether associated with physical signs or not. Several clinical varieties, including mongolism, can be recognized by their physical signs alone. Cretinism frequently waits several months or more before being detected. This is regrettable because promptness of treatment greatly improves the outlook. Cases of mental deficiency without physical stigmata are usually recognized by the end of the first year, when marked by delay of postural control.

The diagnosis of milder cases of mental deficiency in the first few months after birth presents some significant difficulties. We have noted (Chapter XIII) that even mongolism at the age of three months may approximate a normal behavior picture in many individual behavior items, such as visual regard of the hands, vocalization, selective attention to the face, visual pursuit of a moving object. In such plausible approximations to normality, one must give diagnostic weight to the reduction in the intensity and diversity of response. The retardation in the acquisition of postural control of the head is also an important diagnostic sign; though in some cases of debility, and of prematurity, this sign could be discounted.

We recall a vigorous, well-nourished, reactive infant who at the age of two or three months gave a superficial impression of normality, but who was diagnosed as definitely deficient at the age of four months with confirmation of this diagnosis at five and at six months. This case is instructive. The record shows that at two months he gave prolonged regard to the dangling ring; that his head station was more than ordinarily rigid. At three months he was credited with nearly all the developmental items appropriate to his chronological age. He gazed intently at a hanging chandelier. At the age of four months he was reëxamined and the behavior picture was almost identical with that presented at the age of three months. The arrest of development was so complete that a diagnosis of mental deficiency was made. At the age of six months there can be no doubt that this diagnosis was correct.

Now there are three possible interpretations of this case: 1. The child was normal and the deficiency was caused by some intercurrent disease. 2. The child was symptomatically normal, because up to the age of four months, only

the lower, subcortical centers are normally mature and these were not involved in the cerebral defect. 3. The child only simulated normality, but was actually defective in his behavior symptoms in spite of relatively good scoring on the developmental schedules.

Of these three alternatives, the last seems to us most probable. There may have been an obscure meningitis during the third month. It is most likely that the rigid head station noted was the early sign of an abnormal head retraction which became conspicuous at five months, and was a sign of intrinsic developmental defect. The second alternative virtually suggests that high-grade defectives are normal infants up to the age of four months and then fail to acquire the higher orders of behavior. Their defect lies in this failure; and a diagnosis of defect cannot be made until then.

The internal detailed evidence in the present case and in similar cases which have come to our attention, points to the existence of dynamic reductions in the behavior picture which foreshadow defect. The normality is a simulation. In this case the simulation was reinforced by physical vigor, by normal physical appearance, and by absence of medical complications. Intent fixation upon a chandelier is not a certificate of normal attention at three months. There is little doubt in our mind that a critical normative comparison with the behavior day of a normal two or three months infant would have disclosed subtle but really significant differences in behavior output and behavior patterns. The nature of these differences should be clarified; because in them lies the possibility of discovering the existence of mild developmental defect as early as the second month. It is unjustifiable to assume that the very young normal infant and the very young defective infant have the same behavior equipment.

### 4. DIFFERENTIAL DIAGNOSIS BETWEEN DEBILITY AND DEFECT

In the foregoing instance, the infant was physically vigorous and well developed. The difficulties of early diagnosis are greatly increased when the suspected defect is complicated with subnormal physical conditions which depress, obscure, and distort the behavior picture. The nature of these difficulties can be illustrated by an analysis of the diagnostic problem presented in a tiny infant of five months, M. P., who at that age was scarcely above the average birth weight (his weight was 4100 grammes), and who was extremely quiet and nonreactive because of physical debility. The details of this case are worthy of report, because of the general considerations to which it points.

This diminutive child was observed in a hospital crib for the space of an hour. He had just wakened from sleep; made no protest to examination; and remained strangely quiet for about forty-five minutes. Then somewhat to our surprise he babbled with a slight crowing, in a feeble, thin voice, for five minutes. The following summary is based on a memorandum made immediately after the examination.

M. P.'s optimum behavior consisted in: 1. His vocalization. 2. A somewhat persistent effort at turning from the dorsal to the prone position; with a little assistance he accomplished this turn. 3. Manipulation of the ring. This manipulation consisted in a rhythmic clasping and unclasping with recurring transient inspection and a slight degree of follow-up. 4. Anticipatory bracing against return to dorsal position. There was a slight degree of visual fixation on a cube when it was presented on an improvised table on his lap.

In prehension he was slightly above the stage of grasping on contact, and in the lower levels of reaching on sight. He could pursue with grasping a ring, if it just dropped out of his hands, but did not pursue it if it was held at a distance. In other words, reaching on visual cue was not established. Closing in on the dangling ring was practically absent. There was increased activity, visual fixation, and some slight movement of the right hand and arm, but not a characteristic, well-defined closing in.

From the standpoint of purely descriptive diagnosis the case is relatively simple. The behavior picture on the whole approximates the four months level. From the standpoint of developmental prognosis, however, this case presents a few difficult and interesting considerations. Since the child is not much above ordinary birth weight, one could ascribe his retardation somewhat vaguely to nutritional factors. How might these nutritional factors operate to depreciate his development? There are three possibilities.

1. Because of faulty nutrition, normal maturation has not taken place in the growth of his nervous system; he is therefore below his potential level of development in a quantitative sense.

2. For altogether obscure chemical reasons the structures which underlie his behavior have been impaired by faulty metabolism; the structures therefore are themselves faulty in some histological sense, and therefore we have impairment of response, although response itself is present. In some respects this is a fair characterization of this child's condition. For example: He manipulates a ring, but he does it in a feeble and discoördinated manner.

3. Or we might assume that the faulty nutrition has impaired his whole organism in a dynamogenic sense. He therefore cannot muster or release the fund of energy neces-

sary for more alert, more persistent, and qualitatively more coördinated and integrated behavior. This possibility might permit us to account for the subnormal behavior in terms of general debility. If this is true, improved nutrition will presently make this child brighter and more active in both a physical and a mental sense. If one follows the above line of reasoning, one will give favorable weight to the behavior which has manifested itself in spite of nutritional handicap, and also give favorable weight to the active vocalization above noted. This vocalization might then be interpreted as a token of something much better which the child might do if his nutritional status were more nearly normal. Let this nutritional condition become normal and his vocalization will become less faint, will become more vigorous, and become more complicated and also more socialized.

Optimistically, then, one might say that the child is, after all, only one month retarded, in spite of an extraordinary nutritional handicap, and that the outlook therefore, is relatively normal and that we are dealing, at worst, with a child of dull mentality.

Taking a more critical line of thought, the following considerations and possibilities suggest themselves:

1. The nervous system as a rule is the most resistant of all organs to the adversities of starvation and malnutrition. It is even possible, as has been suggested, by some pediatricians, that faulty nutrition may in a compensatory way, for survival reasons, increase alertness, perceptiveness, reactiveness. Mental growth is in no sense an index of weight, and this child has sufficient stature and sufficient energy to present a much more decisively normal behavior picture.

2. Clinical comparisons, if properly founded, can never be invidious. Therefore we may compare M. P. briefly with

N. Q., who occupies a neighboring crib, was born about two months later, and who has a comparable weight (4040 gms). Although we gave only incidental attention to N. Q., it was evident throughout the examination that he was more attentive, reactive, and normal in every way. To be sure the malnutrition of N. Q. may be quite different in its essential nature from that of M. P., but if there is any nutritional equivalence in the two children the relative normality of N. Q.'s behavior casts more suggestive doubt on the ultimate promise of M. P.

3. The fact that M. P. did babble for several minutes at a stretch suggests that there is no functional reduction in available energy. A child with a serious damage of dynamogenic capacity might well have maintained a self-protective silence. Such silence frequently occurs in certain types of debilitating illness. Moreover the vocalization of M. P. was on a low level, suggesting three or four months quality.

Qualitatively, the behavior of M. P. rates consistently low. We are disposed to think of it as being subnormal, or defective, rather than of low average quality. If one compares from the standpoint of quality (including attentional tension, attentional shifts, social responsiveness, emotional vividness, diversity of reactiveness, etc.) the organic behavior picture of M. P. with that of a representative, normal child of four months, the subnormality of M. P.'s present behavior becomes more evident. Clinically we are better justified in weighting this subnormal quality as being more significative than the temporal retardation as such. If this retardation in quality can in no sense be ascribed to debility, or to faulty metabolism, as such, it represents a low grade of nervous organization or of general constitution. It then becomes extremely doubtful whether improved metabolism, as such, will remove this subnormal quality. If this surmise is

correct, the clinical diagnosis and prognosis point toward mental defect.

4. There is, however, one further consideration which would require us to be altogether provisional with respect to prognosis. This is the indeterminable factor of conceptional age. This child was born with a weight of approximately five pounds. It is altogether possible that the child is therefore one month premature. Therefore, he is virtually four months of age instead of five months of age, because his present legal age is spurious to the extent of one month. If he is indeed less than five months of age by the corrected genetic almanac, then he approximates somewhat more closely a normal behavior status and is entitled to correspondingly more favorable prognosis.

It was impossible to make the contemplated reëxaminations of this child, but even in its present state of inconclusiveness this case may serve to illustrate the problems of differential diagnosis which are so significantly embodied in those syndromes in which nutritional and behavior deficiency are combined. From the standpoint of medical science cases of this kind should particularly repay exhaustive clinical study with regard to both their physical and psychological factors. Indeed, cases of retardation will repay systematic study for the light that they will throw on the fundamental mechanics of all development, whether normal, subnormal, or superior.

## 5. EARLY SYMPTOMS OF SUPERIOR ENDOWMENT

It can scarcely be said that the discovery of superior ability, while it still lies in the cradle, has become a social or educational problem. We know too little about the whole question of genius and talent to warrant any ambitious

practical programs. But here as elsewhere, scientific knowledge alone can furnish the necessary guidance to practical procedure. As this knowledge grows our methods of treating infants will become more individualized, which is precisely what should happen, because the present tendency is to regard infants as a highly homogeneous group, readily characterized and managed by single formulae.

For this as well as for scientific reasons, the early symptoms of superior equipment become of some importance. That "superiority" (unfortunately there is no substitute for this unsatisfactory term) is heralded in many instances by precocity cannot be doubted. School surveys have shown repeatedly that the brightest pupil is more likely to be among the youngest rather than among the oldest of his educational group. The chapter on acceleration (Chapter IX) has supplied evidence on this point. Quickening of tempo is one way in which superior endowment is matured; as though nature made haste because there is more developmental ground to be covered in the case of the exceptional individual. This speeding up is manifest in early infancy and probably exists in the intra-uterine period; because it appears that in cases of truly preëminent ability the whole life cycle is somewhat altered. At any rate, we are not permitted to think that superiority comes by way of a discrete instalment upon an ordinary foundation. The genius shows his distinction in his youth, in his later childhood, in his early childhood. Why not, also, in some adumbrating manner, in his infancy?

Precocity, however, is an abstract term. There are clinically different kinds as well as degrees of precocity; and the prediction of superior endowment is made more difficult because it is necessary to recognize the biological quality of any given precocity. Precocity merely in the sense of

increased rapidity of rate does not of itself signify superiority. It might point in an opposite direction. Should we find that the pigmies of Africa learn to stand, walk, and reach earlier than Caucasians it would not denote that the latter are retarded and inferior. Indeed even among Caucasians it is not yet certain that motor precocity augurs ultimately superior attainment. When species are compared the ultimate level of adult organization tends to vary inversely with developmental precocity. When individuals in a single species are compared, adult organization tends to vary directly with developmental precocity.

Medically there are abnormal forms of precocity that are due to acceleration of senility rather than intensification or speeding of infancy. Although these latter forms of precocity are pathological, they suggest factors which may mislead prediction.

The term "superiority" is of course an oversimplification. There are different clinical varieties of superiority, and its early symptoms must vary accordingly. It is possible that exceptional intellectual ability asserts itself in accelerated development of language and adaptive behavior; while exceptional ability in artistic or executive directions has less marked effect on these behavior fields. A complex of musical talent might express itself in a specific manner without much deviation in the general course of development.

Granting all of these qualifications, it is still true that superior equipment in general adaptive behavior may declare itself as early in infancy as mental inferiority, though not with the same clearness. The superiority expresses itself in dynamic excellence, in intensification and diversification of behavior, rather than conspicuous acceleration. Indeed the maturity "level" is less affected than the vividness and vitality of reaction. The young infant with superior promise

is clinically distinguished not so much by an advance in "developmental age" as by augmented alertness, perceptiveness and drive. It is probable, also, that the total behavior of such an infant contains significant differences in the economy or distribution of a day's energy. The infant of superior equipment exploits his physical surroundings in a more varied manner, and is more sensitively responsive to his social environment.

It is certain that there may be specific acceleration of special gifts or talents, including language. Consistent language acceleration before the age of two years is one of the most frequent symptoms of superior intelligence. General motor ability and neuromuscular maturity as revealed by drawing and coördination tests are not necessarily in advance in these cases. The most uniform symptoms of later ability which we have found among infants relate to dynamic intensification, and versatility of response.

Differences which are vaguely called "qualitative" appear when two normal infants of the same age but unlike in fundamental endowment are placed side by side for comparative observation. Many of these differences are essentially quantitative and there is no reason why they should not eventually yield to measurement. At present superiority of capacity is more difficult to diagnose in infants than developmental inferiority. It seems, however, that the small and subtle differences suggestive of superiority which consistently reappear in a series of examinations, have predictive import, and foretell differences which later are conspicuous.

### 6. THE RECOGNITION OF ATYPICAL DEVIATIONS

In a previous chapter (Chapter X) we have given prominence to certain exceptional cases in which the develop-

mental complex pursued an atypical or irregular course. These cases represent, at least, certain hazards and difficulties in the path of developmental prediction. These cases suggest also the very great importance of clinically weighting all the possible factors, particularly those of a medical nature which may enter into the individual developmental history.

Physical complications may be overweighted as well as underestimated. It is not the subnormality in weight or the debility as such which impedes the tide of development. To a remarkable extent the maturation of the nervous system pursues its course in spite of undernourishment and intercurrent illnesses; but there are types of malnutrition which have a depressing effect upon neuromuscular activity. These introduce an aspect of retardation into the behavior picture which may be misleading. In some instances the inactivity is purely defensive; the structures and the competency are present; but they are not utilized. A child convalescing tediously from an illness may be able to talk; but does not choose to talk. Again there may be neuromuscular impairment which dates to some metabolic fault in early infancy, but is slowly compensated for in later life. Restriction and paucity of experience among hospitalized and institutionalized infants may greatly reduce the behavior output, particularly when associated with personality restrictions as often happens. Sometimes, likewise, extreme inattention to an infant in a family home leads to a kind of isolation which affects behavior, and may falsify the behavior indices.

The only way in which serious error in prediction can be avoided in these atypical cases is through a cautious recognition of the secondary factors which depress the behavior picture, and the latent compensatory possibilities, particularly, in the motor field, which may later improve it.

Atypical cases are not, of course, in any sense lawless or accidental; they simply are less familiar and do not yield as readily to accustomed standards and procedures.

If we were in possession of a biometric diagnostic scale which worked with automatic precision, a discussion of clinical prediction would be superfluous; for then each individual measurement and each group of measurements would denote a future as well as present behavior value. It is because we are so far removed from such Utopian perfection, that emphasis must be placed on the importance of clinical experience and clinical method. There is no occasion, however, for complete diagnostic agnosticism! In spite of its obscurities and its ambiguities infancy is prophetic. The child is not a creature of circumstance. He is part and parcel of the great stream of life. He is biologically father of the man. And the infant is father of the child. Adulthood is not added unto infancy; it inheres in infancy. Because of this inherent continuity in the life cycle there is ample scope for progressive prediction in the consecutive study of infant behavior.

The following chapter is a summary statement of general principles which underlie the measurement and prediction of mental growth.

# CHAPTER XIX

# THE MEASUREMENT OF MENTAL GROWTH

## Principles of Developmental Measurement and Prediction

Embryology is the cardinal science of development. Broadly conceived, embryology embraces not only anatomy, but all knowledge which bears directly upon the phenomena of growth.[1] In a schematic sense, even developmental psychology falls within its scope.

Wilhelm His, one of the founders of this science, held that "The ultimate aim of embryology is the mathematical derivation of the adult from the distribution of growth in the germ."

How is that derivation to be achieved? Can it be achieved at all in the psychological field, in the embryology of the mind? One cannot take too much for granted. Is it possible that development, in the mental sphere, is not in itself a valid scientific problem? It may be a philosophical conception which has its place in the metaphysics of Heraclitus, Bergson, and Driesch, but which should be used with great scientific wariness.

Certain distinctions must be made between the concept of mental ability and of mental growth. In a recent volume on *The Measurement of Intelligence*, Thorndike remarks that "The great merit of the Binet test is that it is a graded

[1] In this summary no attempt will be made to maintain a distinction, of doubtful value, between growth as augmentation and development as differentiation.

scale for intellectual difficulty, and it is only weakened by being interpreted loosely as a measure of some mysterious essence called intelligence, which grows in man." The validity of the idea of intelligence level, and even the value of the concept of mental age, have been questioned. One may, indeed, ask in a critical vein, of what importance for developmental psychology is the category of age.

Although Thorndike discusses intellect in relation to age, he is chiefly concerned with the direct measurement of intellect as such, intellect as capacity. He proposes new methods for determining the altitude, the width, and the area of intellect, and makes this significant comment: "Only one thing is needed to make such measurements submissible to the arithmetic and calculus of science in general. That is the expression of the altitude of each level (now merely a rank) as an amount of difference from the altitude of others and from some group of tasks which require intellect, but so little of it that they border on a true zero of difficulty which may be set as their lower limit. This is the fundamental problem of mental measurements." This statement expresses the positivist standpoint of absolute psychometry and must have application to many phases of quantitative technique.

## 1. DURATION AND THE SECULAR ZERO

The absolute measurement of abilities, however, leads to questions concerning the measurement of growth as such and invites also a consideration of the import of age in relation to mental growth. At the present stage of scientific method, it would seem that many problems of genetic psychology must still be approached in a relative manner, even in their quantitative aspects. From the standpoint of genetic psychology, and of psycho-biology, the mind as mind, capacity as capacity, behavior as behavior, cease to be of

central concern and become rather the foils for the dynamic study of change in relation to duration. Duration then becomes a fundamental category. It is the growth, the alteration, the emergence, interplay and time progression of factors, which call for formulation. Mental growth makes a successful contest with zero at many different points, or it is a process which cumulatively creates new conventional zeros and brings them into shifting relations. It is the dynamics of this process which in some way, however crude, needs delineation combined with measurement. The delineation must take fundamental account of the factor of age. The elucidation of agedness in relation to maturation likewise becomes a task for systematic research.

We therefore assume that mental growth in this dynamic sense *is* a valid scientific problem; that it may be studied in its own right, however heavily the conclusions hinge on static and absolute data. The mental manifestations of growth must be viewed historically, in their natural sequence. It is the grouping and interaction of various manifestations at ascending stages in an age cycle which form the basis for a description of the growth complex and a derivation of growth laws.

Age and growth are inseparable concepts. All growth takes time; but age is more than duration. It is a topographical as well as a quantitative category. Any given age always represents a position in a cycle. For this reason age norms in some form are indispensable to the study of growth.

But what form shall these age norms take? How shall we calibrate age in making our serial cross-sections? Where shall we place our secular zero? Chronometry furnishes us with units ranging from a fractional thousandth of a second to a year; but it does not locate the absolute zero in the

life cycle of the child, nor does it furnish any formula which will equate age-values at remote ends of the life cycle. It has long been the practice to reckon a child's age from the time of birth; but this is a most naïve convention which mocks the dignity of the true zero. Birth itself takes place at different times in the biological sense. This variability of the natal zero introduces interesting and instructive complications into the study of early mental growth.

Time in the Newtonian sense flows at a constant rate. Development flows with some kind of negative acceleration. In the germinal period of the human zygote, hours count; in the period of the embryo, days count; in the period of the foetus, weeks count; in infancy, months. Our prevailing measuring scale for the school child is notched at the years.

There is an involuted compression of development in the early stages; all strands of growth converging upon the zero point. There is an apparently uneven tapering of these strands into the zone of senectitude. As we reach maturity the age level concept becomes more difficult of application; but it does not lose its essential validity. We are still concerned with increments of growth in relation to duration, and when the processes of development become reversed, so that increments give way to decremental decline, it is still more desirable to keep the methods of description and of measurement continuous with those applied to foetus, infant and child.

In developmental economy the value of any given unit of duration is quite relative and is governed by the secular location of that unit in the life cycle. In early infancy the developmental significance of short intervals is comparatively great. For the infant psychologist the wrong end of the field glass is perhaps the right one, because he must view the rapid elaboration of early behavior through time lenses

which will deepen perspective and restore the compressed events to their intrinsic developmental proportions.

## 2. THE QUANTITATIVE FORMULATION OF GROWTH PHENOMENA

The mechanics of growth may some day be formulated in biochemical or physicochemical terms; but even then we shall need some quantitative logic or graphics to express the dynamic configuration and the temporal design of the total growth complex. The analysis of lines and foci of growth with reference to their interplay, their competition or autonomy, their rhythms, fluctuations, dominance, subsidence and integration, must be quantitatively or graphically portrayed in systematic relation to the factor of age. The study of the crucial problem of maturation likewise must give consistent heed to the clock and the calendar.

If our general interpretation is sound, the following propositions may be laid down. For the sake of brevity they are worded rather categorically:

1. Growth, as growth, is a genuine scientific problem, whether conceived in physical or mental terms.

2. Mental growth can be studied through systematic inventory, seriation, and mensuration of behavior phenomena at any successive points of any part of a life cycle.

3. The location and dynamic significance of the phenomena must be expressed in terms of age or its equivalent. Age is an orientational as well as quantitative category.

4. Absolute mensuration of traits and capacities is technically essential, but must be supplemented by historic and naturalistic interpretation. Relative as well as absolute units must be used to elucidate data. Even descriptive normative formulations are valuable if they are made objective and comparative. Developmental increments may be profitably

studied by the method of paired comparison of adjacent age levels.

5. Growth is a continuum-complex of variable and more or less elementary components. The constellation of components needs graphic and mathematical expression. The concatenation of components can be determined only through clinical and experimental observation.

6. Clinical and experimental observation are not mutually exclusive. Rather they are reciprocally corrective. In the complicated field of human growth they should reinforce each other. Clinical approach is peculiarly important in the study of mental growth; because growth is always a unitary end-resultant of multiple factors in one individual. Individual differences in modalities of growth must be investigated as well as more purely quantitative deviations.

7. Growth changes may be studied through the genetic seriation of increments of behavior values and a parallel seriation of decrements. A genetic order is more than a rank order and need not be reduced to absolute or uniform units to be scientifically serviceable.

Such increments may be formulated for specific functions or even for such complicated aggregations as personality. The number of stages and corresponding norms of development which may be studied approaches infinity.

8. A critical recognition of the influence of age in growth is needed to determine the stages of growth which can be most advantageously studied in the field of child development. The compression of development about the zero point places a scientific premium on the early age levels.

9. The reckoning of chronological age from the time of birth presents both theoretical and practical difficulties for genetic research. Birth marks the location of a nodal but not a true zero. From the standpoint of psycho-biology

there are numerous other nodal zeros, but the absolute zero for reckoning life age should be placed at conception.

10. Age norms must be multiplied as well as refined for the study of early mental growth. The rapidity of circum-natal development demands an increasing regard for small units of duration at this sector of the growth cycle.

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In spite of its prodigious intricacy, mental growth should yield to measurement and to prediction. Growth is without caprice. Growth is a progression which proceeds in orderly relation to age from conception to death. A scientific exploitation of the age factor will inevitably lead to some kind of extrapolation of the pattern of future growth. The refinement of this extrapolation is prediction. If prediction is the essence of science, mental growth has a better scientific status than many problems which seem more simple and more valid.

Growth is lawful. The seasons in their sequence and in their consequence are so ordered that Thoreau boasted that he could tell the day of the month within two days by the flowers that grew. In spite of its bewildering complexity, the growth of the child mind also will be found to be within the realm of law.

# CHAPTER XX

# GROWTH AS A MEDICAL AND SOCIAL CONCEPT

## The Control of Early Human Growth

The growth of plants, of animals, and of children has since very ancient times been a subject for observation and reflection. Even in primitive ages man must have made dim speculation concerning the process behind the ever present manifestations of development. This process was so potent and so certain, that it entered into his cosmic and religious interpretations. He thought of it as he thought of the movement in the river, the tide, the wind, the sun. His notions, when they became intellectualized, were naturally naïve and animistic. It was logical for him to deify the sources of life, and to posit demons and goddesses of growth and of fertility. So Ceres antedated the science of agriculture.

### I. THE FOLK CONSCIOUSNESS OF GROWTH

To this day we retain some of the primitive concept of growth; probably because the primitive notion was not without a germ of truth. It is impossible to conceive of growth except as some form of movement or progression in time and space. Moreover, even scientifically, growth suggests itself as some natural force, just as gravitation, electricity, and heat may be regarded as forms of force or energy. To be sure the rationalistic approach requires that the "force" aspect of growth be reduced to an interpretive minimum. But after all has been scientifically said, growth

remains an active, dynamic manifestat on of nature, which is fundamentally no less real and no less mysterious than the natural physical forces which man s bringing under his control. Will organic growth also come within the range of control?

A history of the scientific aspects of plant and animal husbandry could be written around the central theme of growth. Such a history would show that the race has slowly acquired an important body of knowledge concerning the laws of growth in the wide domain of agriculture. A history of recent and contemporary biology would show a significant concentration on the problems of growth as they apply to the human race as well. Indeed the modern investigations into the evolution of the race have laid the basis for a new comprehension and control of the development of the individual. Some of the primitive sense of mystery in regard to growth is giving way to insight, and a sense of protective regulation. Normal growth is becoming a guiding concept in child hygiene. The protection of the optimum growth of the infant is a form of social control which is now in a rudimentary stage of development, but has an important future, — unless the promise of present day biological science is quite unfounded.

Under pastoral conditions of life man was more closely confronted with the phenomena of growth than in highly industrial, urbanized surroundings. The earlier conditions gave him, perhaps, a deeper feeling for the facts of growth. In the Oxford Dictionary one may find numerous quaint words which relate to growth. The words seem quaint, because we no longer use them in the naïve manner of our forefathers, but they are very excellent words for a lexicon of development. There are such words as growable, growthful, growthy, growthless, growthsome. From a book on

sheep farming, the following is quoted: "Such lambs are not desirable and neither are those that do not appear growthy!" And, "It's a fine growthsome morning," means of course a weather that makes things grow. But this is scarcely a byword for the crowded city. Under modern urban conditions, nature study and biological science are needed not only to inform, but to restore to youth a sense of the development of living organisms. Such perception for the facts of growth has more than a remote significance for preparental education.

Every newborn infant reintroduces into the world the age-old miracle of human growth. No matter how mechanized, how artificial, the physical conditions of the home, each birth becomes the starting point for a new reckoning with the potentialities of growth and for a series of far reaching socialized measures. In primitive days, rites and traditions prevailed and sufficed. To-day, in a typical modern community the advent of the infant mobilizes an elaborate, purposeful technique, which expresses the protective foresight of the state, and the application of medical science to the preservation and promotion of life. This technique is of relatively recent date. Pediatrics is a new subdivision of medicine. The first infant welfare station was established a mere generation ago. Systematic health supervision of the infant is only in its beginnings. But in principle a revolutionary increase in socialized control has been achieved. The new attitude and the new technique in the field of infant hygiene constitute the most significant advance which has yet been made in preventive medicine.

## 2. THE MEDICAL SIGNIFICANCE OF THE CONCEPT OF GROWTH

At present the central concern of infant hygiene is the prevention of disease and of defect. But in this very effort

hygiene takes on a positive outlook and places a premium upon optimum nutrition. The concern for normal nutrition in turn readily widens to include the total developmental economy of the child. By context and through necessity the behavior aspects of both parent and child come into the scope of supervision. The needs of the infant are so interrelated that his mental as well as physical well-being fall naturally under medical oversight. The unifying concept of optimum growth can make no artifical distinction between mind and body and serves to protect his entire welfare. The instinctive concern of his parents is in harmony with this same concept. The very nature of infancy compels a fundamental, integrating regard for all the conditions of growth.

Growth becomes, then, the most significant term in the vocabulary of child hygiene. Growth has a meaning more pregnant even than the word health. It carries a more dynamic connotation; it organically ties the present with the past and directs it toward the future; it places an emphasis on the entire economy of the individual and a premium upon a consecutive, progressional form of developmental supervision.

This supervision can be evolved no more rapidly than the advance of scientific knowledge of the laws and conditions of growth. At present there are important activities in the field of parent education. The nursery school movement is revealing concretely the nature of concrete problems of child training and of parent guidance. By a process of downward filtration, the school practice of making psychological measurements of intelligence has been extended to children of kindergarten and prekindergarten age. These measurements are serving to show the existence of significant individual differences among young children. Public school responsibility in regard to preparental education entails increasing contact with children of yet younger age.

It does not follow, however, that the developmental supervision of the early period of childhood will be accomplished through a downward extension of public school provisions. The protection of the early growth of the child is essentially a medical and a biological problem. It needs not only the technique but the mores of medicine. This will be increasingly true as the psycho-biological sciences yield the fruit of their investigation and experimentation. When knowledge becomes ripe for application, the application will of necessity be individual and will require the safeguards of clinical medicine. The methods of pediatrics and of the infant welfare center hold a germ capable of endless development in the supervision and control of human growth.

The infant embodies life while it is in the most sensitive, the most responsive phase of the cycle of growth. He holds the Promethean sources of life. Small but fundamental alterations of his early nature will project themselves throughout the entire life cycle. Through unremitting inquiry and measurement it will be learned how wisely to make these alterations. Science has entered the outskirts of this new domain of conscious control.

There is no prospect that cherished human values will suffer in this effort to control more systematically the course of individual growth. On the contrary, the very effort implies a heightened regard for the import and the plasticity of infancy. For better, not for worse, science has undertaken to define the well-springs and the lawful determinisms and the compliant essence in human growth.

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[Names of persons and of clinical cases are printed in italics.]